Section 4
Biological Resources

This section describes terrestrial and aquatic biological resources in the study area and the potential changes that could occur as a result of implementing the Delta Plan and the project alternatives. It describes the environmental setting, potential environmental impacts, and proposed mitigation measures.

The Delta Plan (the Proposed Project) does not propose implementation of any particular physical project; rather, it seeks to influence, either through limited policy regulation or through recommendations, other agencies to take certain actions that will lead to achieving the dual goals of Delta ecosystem protection and water supply reliability. Projects may include water and wastewater treatment plants; conveyance facilities, including pumping plants; surface water or groundwater storage facilities; ecosystem restoration projects; flood control levees; or recreation facilities. This is described in more detail in part 2.1 of Section 2A, Proposed Project and Alternatives, and in Section 2B, Introduction to Resource Sections.

The types of changes that could impact biological resources include land use changes, conversion or inundation of habitat (including agricultural lands), disturbance associated with construction and use of facilities, and changes in stream flow and water quality. These types of activities could alter, damage, or destroy biological resources, resulting in an impact on these resources. Construction- and operations-related impacts on biological resources could be significant depending on various project- and site-specific factors that are presently undefined. This section identifies mitigation that could be considered by lead agencies to develop specific mitigation measures for future projects involving biological resources. The mitigation may reduce impacts to less than significant; however, depending on the specific characteristics of the project and the environment, not all mitigation measures identified would mitigate impacts to a less-than-significant level.

4.1 Study Area

The study area for this section encompasses the Delta, including Suisun Marsh; riparian and riverine natural communities within the Delta watershed, including eastside and westside tributaries (Sacramento and San Joaquin River watersheds); and areas located outside the Delta that use Delta water. As described in Section 2A, Proposed Project and Alternatives, facilities could be constructed, modified, or reoperated in the Delta, Delta watershed, or areas located outside the Delta that use Delta water. It is unclear where these facilities would be located. The Delta is the focus of the Delta Reform Act, so the study area for this resource is focused on the Delta and Delta watershed.

4.2 Regulatory Framework

Appendix D provides an overview of the plans, policies, and regulations relating to biological resources within the study area.

4.3 Environmental Setting

This section describes the biological resources that could be potentially affected as a result of adopting the Delta Plan or implementing the alternatives. Biological resources are described in greater detail for the Delta and Suisun Marsh than for the Delta watershed and areas outside of the Delta because Delta Plan actions would be focused primarily in the Delta and Suisun Marsh. For each of these geographic areas, a description of the biological communities and common fish and wildlife, special-status species, and major invasive species is presented. A brief discussion of the historical modifications to aquatic and terrestrial biodiversity of the Delta and Suisun Marsh and their causes also is included because it is central to an understanding of the current status of biological communities and special-status species. The scientific names of plant and wildlife species mentioned in the text are presented in Appendix F-1, Common and Scientific Names of Plant, Fish and Wildlife Species Mentioned in the Text.

4.3.1 Major Sources of Information

Most of the information in this section is summarized or taken directly from existing documents. Major sources of information for this section include but are not limited to:

- Federal listing notices and Critical Habitat Designations published in the Federal Register.
- Biological Opinion and Conference Opinion on the Long-term Operations of the Central Valley Project and State Water Project (NMFS 2009a).
- Biological Opinion on the Long-Term Operational Criteria and Plan (OCAP) for coordination of the Central Valley Project and State Water Project (USFWS 2008a).[1]
- Public Draft Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon and the Distinct Population Segment of Central Valley Steelhead (NMFS 2009b).
- CALFED Ecosystem Restoration Program documents, primarily the Ecosystem Restoration Program Plan, Volume I: Ecological Attributes of the San Francisco Bay-Delta Watershed. (CALFED 2000a).
- Conservation Strategy for Restoration of the Sacramento-San Joaquin Delta Ecological Management Zone and the Sacramento and San Joaquin Valley Regions (DFG 2011a).
- The discussion of historical trends in the biodiversity of the Delta and Suisun Marsh is largely based on the report *From the Sierra to the Sea: An Ecological History of the San Francisco Bay-Delta Watershed* (The Bay Institute 1998). This in-depth study was funded by David and Lucile Packard Foundation, the U.S. Environmental Protection Agency (USEPA), the CALFED Bay-Delta Program, the Metropolitan Water District of Southern California, the National Fish and Wildlife Foundation, and California Urban Water Agencies.
- Special-status species information was based on the California Natural Diversity Database (CNDDB 2011), the California Native Plant Society's (CNPS) Inventory of Rare and Endangered Plants of California (CNPS 2011), and the U.S. Fish and Wildlife Service's (USFWS) online Sacramento Fish & Wildlife Office list of endangered species (USFWS 2011a) and the California

[1] In December 2010, Judge Wanger ruled that portions of the USFWS Biological Opinion and supporting NEPA documentation were inadequate and remanded the Biological Opinion to USFWS for further consideration in accordance with court's decision and the requirements of law. Those disputed portions of the Biological Opinion were not relied upon in the preparation of this report.

Department of Fish and Game's (DFG) Special Animals List (DFG 2011b) and Special Vascular Plants, Bryophytes, and Lichens List (DFG 2011c).

- Information on natural communities in the Delta was obtained from DFG GIS data (Hickson and Keeler-Wolf 2007); information on natural communities in the Suisun Marsh was obtained from the San Francisco Estuary Institute's electronic EcoAtlas (SFEI 1998); and information on vernal pool habitat in the Central Valley was based on GIS data prepared by Dr. Robert F. Holland (2009a).

4.3.2 Delta and Suisun Marsh

4.3.2.1 Factors Affecting the Delta Ecosystem

The current environmental setting for biological resource in the Delta and Suisun Marsh is the result of years of human activity that have fundamentally changed the Delta ecosystem. Today's Delta, in most respects, is completely unlike its condition prior to European settlement and unlike most any natural estuary around the world. Human activity has altered the geometry of the estuary through diking former wetlands and floodplains; connecting most all waterways and converting them into levee-bounded navigation and conveyance canals; changing flow regimes to move Sacramento and San Joaquin river water south to the South Delta export pumps; regulating salinity in an attempt to meet conflicting demands for water quality, water supply reliability and ecosystem needs; constructing dams to control the flow of water; and discharging agricultural, urban, and industrial waste into the waterways. The result is a highly uniform (i.e., low variability) system, with a substantial reduction in complexity, and degraded water quality.

These historical modifications of ecosystem processes and functions in the Delta and Suisun Marsh have substantially influenced the current condition of biological communities and special-status species. Understanding the current setting for biological resources in the Delta and Suisun Marsh is aided by an understanding of how those historical activities affected important ecosystem processes in the Delta. The following provides a brief overview of the factors and processes that led to the formation of the current conditions for biological resources.

4.3.2.1.1 Physical Habitat Loss

The conversion of land in the Delta, primarily for the purpose of agricultural development, resulted in the removal of wetlands, floodplains, riparian vegetation, and grasslands that provide habitat for Delta species. Of the 320,000 acres of tidal marsh present in the Delta (The Bay Institute 1998) and 67,000 acres present in Suisun Marsh (Monroe et al. 1999) at the time of California statehood (Figure 4-1), roughly 90 to 95 percent have been drained or reclaimed (Figure 4-2). Aside from a few in-channel islands, the Delta has no remaining large tracts of tidal marsh. The only tidal marsh remnants in Suisun Marsh are Brown's Island at the confluence of the Delta and Suisun Marsh, Rush Ranch along Suisun Slough, Hill Slough, and Peytonia Slough, which together total approximately 2,700 acres (SFEI 1998). Levee construction and water management afforded by the construction of dams on the major Delta tributaries also resulted in a major reduction in the extent of riparian vegetation and active floodplains. Although remnant and fragmented patches of tall riparian trees, such as Fremont cottonwood, western sycamore, and Goodding's black willow, remain in the Delta, the ability of these species to reproduce is greatly impaired by the lack of active floodplains and hydrologic modifications.

The conversion of land to agriculture also affected upland habitats in the Delta, such as grasslands and vernal pools. These habitats support high levels of biodiversity in the Central Valley (Witham et al. 1998). These types of habitat occur in the northeast and southwest areas of the Delta and along the eastern edge of Suisun Marsh. The vernal pool landscape in the northeast Delta has been affected by leveling for agricultural land uses (e.g., Stone Lakes National Wildlife Refuge [NWR]). The alkali grassland that supports vernal pools in the southwest Delta has been fragmented by agricultural and residential

development and by water management projects. Only very limited habitat remains for vernal pool species, such as fairy shrimp and native plants. It is estimated that throughout the Central Valley, the acreage of grasslands with vernal pools has declined from a prehistoric 7 million acres to approximately 895,000 acres in 2005 (Holland and Hollander 2007; Holland 2009b). Approximately 135,000 acres was estimated to have been lost over the last three decades (Holland 2009b).

The past modifications to the habitats in the Delta and Suisun Marsh have resulted in a substantial reduction in the historical abundance of native fish, wildlife, and plants. Many native fishes are in decline, with seven native Delta fish species now receiving protection under the federal Endangered Species Act (ESA) and two (Sacramento perch and thicktail chub) having disappeared completely (Moyle et al. 2010a, page 4). Mammals such as tule elk also have disappeared, and small mammals, such as riparian brush rabbit, have been reduced in number and now occur only in scattered locations. The number of species of nesting birds and mammals found in the Delta that depend on riparian habitat also has declined in the last 150 years (The Bay Institute 1998).The remnant marshes are now habitat for several wildlife and plant species listed as rare, threatened, or endangered, such as the California black rail and Mason's lilaeopsis.

Although much of the physical habitat for native species has been reduced, the agricultural land that replaced native habitats does benefit some species (e.g., Swainson's hawk and greater sandhill crane) that forage in agricultural fields, particularly alfalfa, irrigated pasture, and grain crop fields. The Delta and Suisun Marsh also continue to provide vital migratory, wintering, and breeding habitat for migratory birds using the Pacific Flyway, especially in designated wildlife management areas (e.g., the Suisun Marsh and Yolo Bypass), where habitat management is optimized for managed species, including waterfowl, shorebirds, and wading birds.

4.3.2.1.2 Connectivity and Interface Loss

The past channelization of rivers and construction of engineered levees constrained flows, disconnected natural habitats, restricted tidal exchange, limited terrestrial inputs, and reduced surface area between water and land. Collectively, the resulting changes compromised a wide range of ecosystem processes, particularly those at the land-water interface. In functional ecosystems, the food web depends upon transport of constituents and organisms between different habitats. Variability in the aquatic environment provides a mixture of biologic, hydrologic, and geochemical conditions that support the development and growth of the different components of the aquatic food web (e.g., algae, invertebrates, and fish). Connectivity between the aquatic environment and the land expands the aquatic food web to include terrestrial wildlife such as birds, waterfowl, and mammals. Through this connectivity, nutrients, micronutrients, ions, sediments and microbes are transported from land surfaces into the aquatic environment. Tidal interactions and tidal exchange directly result in the cycling of water and the constituents and species it carries, and indirectly led to the movement of fish, invertebrates, and other species between habitats in response to the availability of food, changes in cover, and other factors. The current Delta lacks most of the former connectivity between aquatic environments and the surrounding terrestrial environment that is important in the development of an ecosystem's richness and diversity.

4.3.2.1.3 Harmful Invasive Species

The San Francisco Bay Estuary and Delta is one of the most invaded aquatic systems in the world. Recent reports show 193 introduced species (69 plants, 89 invertebrates, and 35 vertebrates) now dominate most habitats within the Delta-Suisun region (DWR 2007a, p. 44). The effects of most introduced species on the Delta ecosystem are unknown, but those that are invasive spread rapidly, become dominant in their habitats, and displace natives through competition, predation, and food web alteration.

Figure 4-1
Historical Natural Communities of the Delta and Suisun Marsh
Source: CalFire 2007, SFEI 1998, STATSGO 1994, USGS 1982; adapted by WWR in 2011

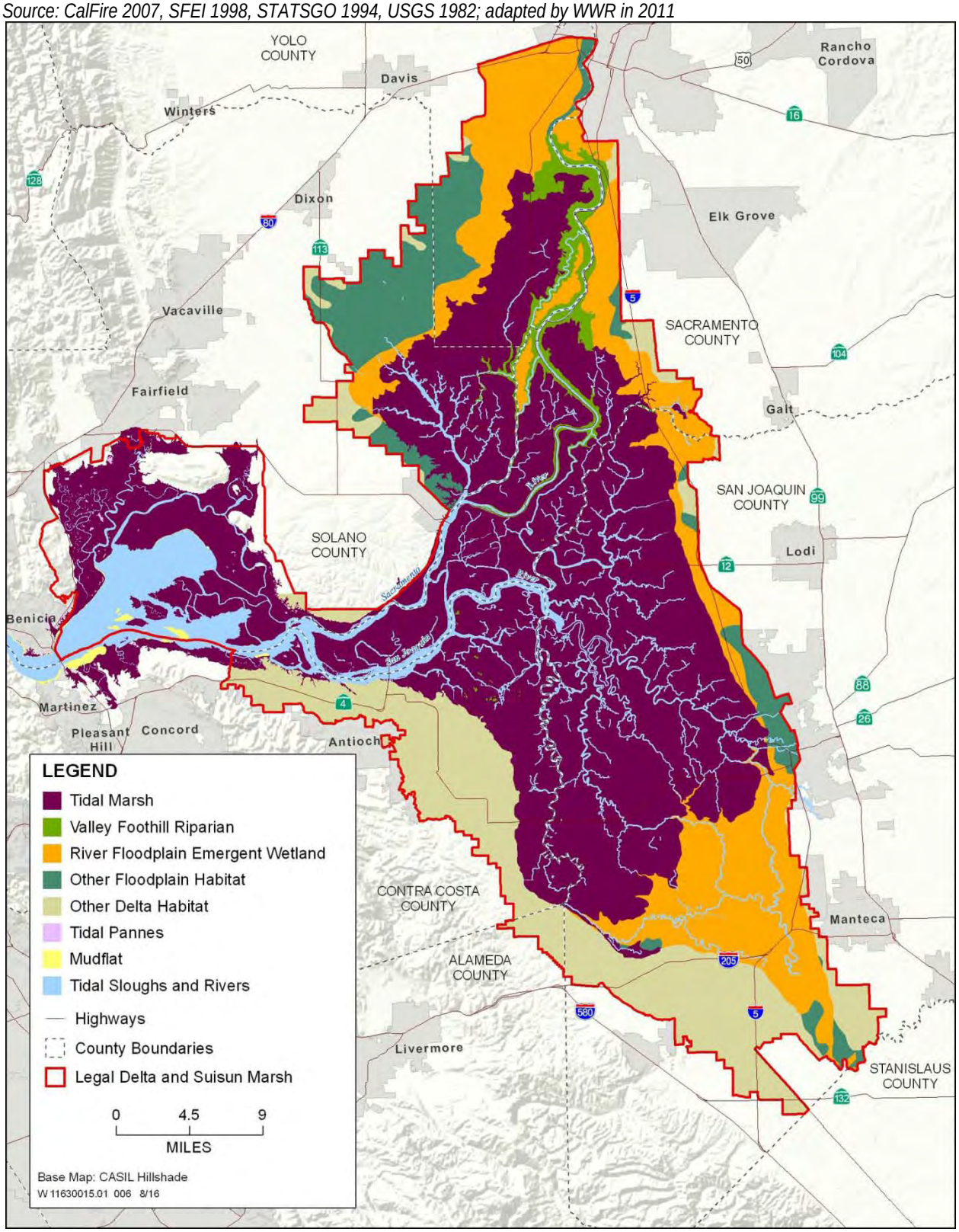
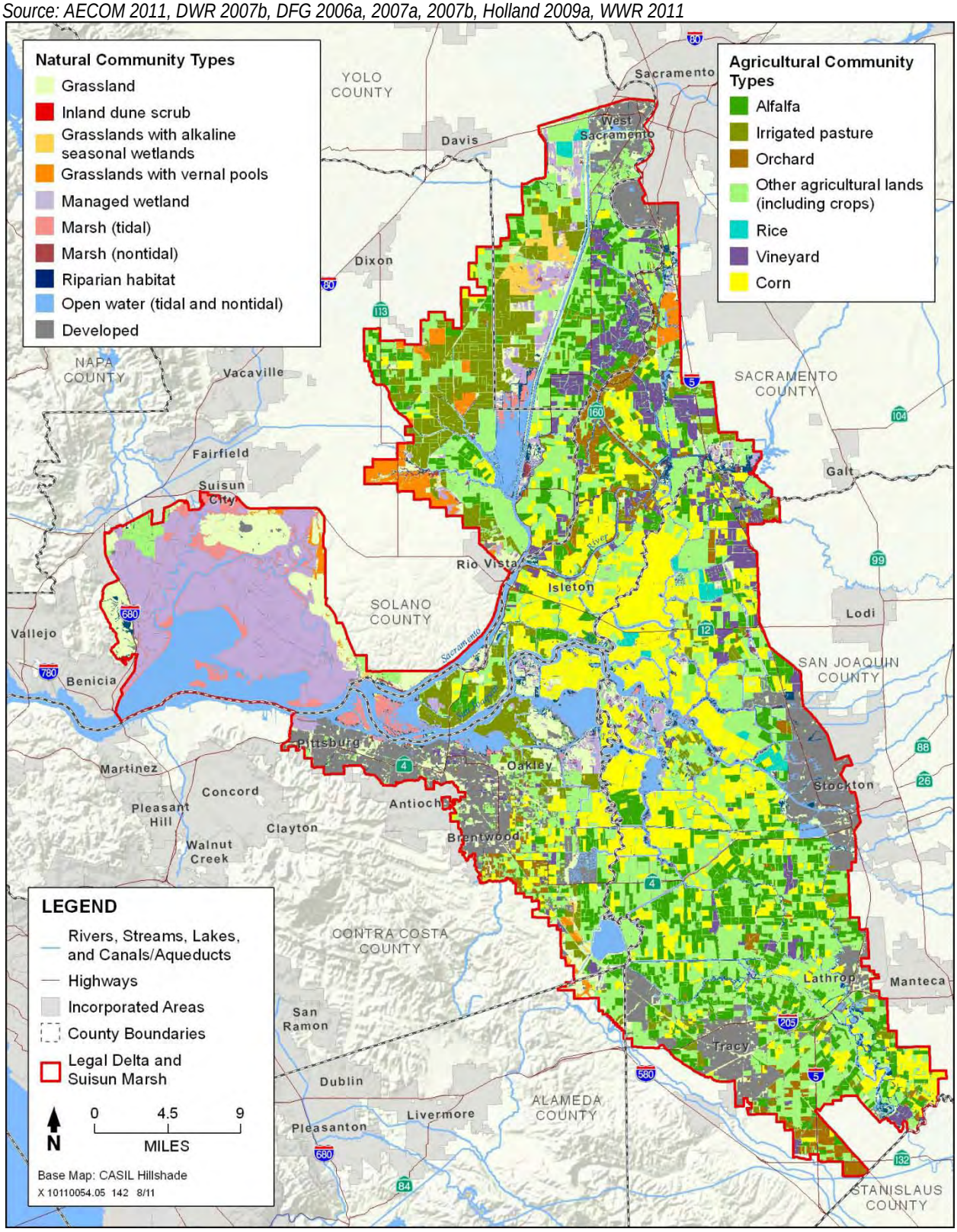


Figure 4-2
Current Natural Communities of the Delta and Suisun Marsh
Source: AECOM 2011, DWR 2007b, DFG 2006a, 2007a, 2007b, Holland 2009a, WWR 2011



Two clams from Asia, the overbite clam and Asian clam, currently dominate the benthos of Suisun Marsh and the Delta, respectively. These species alter habitat suitability, consume vast quantities of primary and secondary production, and alter species composition and food web structure (Lund et al. 2007, p. 71). Among the many introduced fish in the Delta, threadfin shad and inland silversides are some of the most invasive, although threadfin shad abundance has apparently decreased in recent years (DWR 2007a, p. 44). Striped bass and largemouth bass were deliberately introduced and now are among the most abundant fish of pelagic and nearshore habitats. Bass are predatory and have significant negative effects on native species.

Among invasive plants introduced to the Delta and Suisun, the most notable are the submerged aquatic plant Brazilian waterweed and the floating aquatic plant water hyacinth, which can choke low-velocity channels. Both species have greatly affected the aquatic ecosystem by creating dense vegetation canopies in the middle and upper portions of the water column. This dense vegetation slows and alters the directions of flow, facilitates sediment deposition that reduces turbidity, increases surface water temperatures, and can elevate pH during the day and cause significant declines in dissolved oxygen levels at night. The introduction of water hyacinth and Brazilian waterweed has greatly reduced habitat quantity and quality for many native fishes, and has provided preferred habitat for nonnative predatory fish, such as bass and sunfish that prey on native fishes (Nobriga 2008, p. 20). In addition, habitat supported by riparian forest has been degraded by nonnative invasive plants including tree-of-heaven, giant reed, black locust, and blue gum. These plants have degraded riparian habitats by outcompeting native plants that provide better canopy cover, host more insects, and provide greater forage value for native wildlife.

4.3.2.1.4 Altered Flow Regimes

Beginning at the time of statehood and continuing well into the late 20th century, humans have engineered California's water network primarily to support agriculture in the Central Valley and Delta area and to provide water to the state's growing population. These efforts have resulted in substantially altered flow regimes. Historically, flow moved seaward, with seasonal changes in inputs from the San Joaquin and Sacramento rivers as well as the smaller tributaries. Today, net flows in the southern Delta have strong north-to-south directionality (toward the CVP and State Water Project [SWP] South Delta export pumps) and the timing and magnitude of inflows to the Delta are highly regulated to support water supply reliability and salinity requirements. Together, pumping from these export facilities can effectively reverse flows in Old and Middle rivers (The Bay Institute 1998; DFG 2008a).

Flows from the San Joaquin River have been greatly reduced by diversions from its tributaries (Merced, Tuolumne, and Stanislaus rivers) for upstream agriculture. San Joaquin flows often do not transit the Delta but instead are "reversed" through Old and Middle rivers to the South Delta export pumps. The Sacramento River is the major source of freshwater into the estuary but, like the San Joaquin River, much of its upstream flows are diverted for agricultural use before it reaches the Delta. Once reaching the Delta, seasonally varying proportions of Sacramento River flows are conveyed south to the export pumps via seasonal operation of the Delta Cross Channel and pumping volumes at the South Delta export facilities.

While the tides are sufficiently powerful to create an impression of normal land to seaward movement, the net flow at times can be overwhelmed by movement of water towards the pumps in the south Delta. This complex and altered hydrologic regime leads to a confusing environment for migratory fish (e.g., outmigrating juvenile salmon may end up in the central and southern Delta, where water temperatures are higher and water quality is otherwise unfavorable) and it draws others, such as delta smelt, toward the south Delta pumps (Kimmerer 2008, p. 16). In addition, current flow conditions favor resident freshwater invasive organisms such as largemouth bass and Brazilian waterweed (Moyle et al. 2010b, p. 14).

4.3.2.1.5 Altered Geometry

Past construction of levees and channels substantially altered the geometry of the Delta and ecosystem functions. The altered geometry affects the transmission and dissipation of tidal and river flow energy across the landscape and how tidal and riverine waters mix within the Delta. The large expanse of tidal marsh in the historic Delta would have muted tidal energy, spreading it over wide areas rather than confining it into narrow channels (Moyle et al. 2010b, p. 10).

Today's geometry does not dissipate tidal energy effectively, resulting in higher tide ranges farther up the mainstem rivers. The resulting higher energy environments reduce residence times and result in less primary and secondary production. The interconnected waterways in combination with the high tidal energy act to keep Delta waters well mixed, leading to less variation in salinity, which favors invasive species. Flooded Delta islands and the margins of Delta waterways other than the mainstem rivers provide sheltered areas. While these sheltered areas provide some variability in residence time, some of these areas now support Brazilian waterweed that provides habitat for bass and other introduced fish species that prey upon native species. Sheltered waters can also provide conditions that support blooms of toxic blue-green algae (OEHHA, 2008).

4.3.2.1.6 Altered Sediment Supply

From 1853 to 1884, the Delta watershed was subject to large-scale placer mining that resulted in the transport and deposition of large amounts of sediment into the rivers of the Central Valley. This hydraulic mining debris took about 100 years to work its way through the watershed (The Bay Institute, 1998, p. 3-23). In the 20th century, major dams and in-channel sand and gravel mining operations on Central Valley rivers became sediment traps that captured and retained sediment that would otherwise be transported downstream into the Delta. The construction of dams, in combination with the reduction of the hydraulic mining pulse, led to an estimated 50 percent reduction in sediment supply from the Sacramento River between 1957 and 2001 (Wright and Schoellhamer, 2004).

Decreasing sediment input is one of the factors contributing to a recent trend in increasing water transparency in the Delta. Another factor is sediment "washout" from very high inflows in 1982-83, and proliferation of large beds of submersed aquatic vegetation that are "filtering" sediment (e.g., Brazilian waterweed) (Nobriga et al. 2008, p. 10). The reduction in sediment supply and turbidity in the Delta may adversely influence species such as delta smelt. Delta smelt abundance is negatively correlated to water clarity (Nobriga et al. 2008, p. 10), and a reduction in turbidity may reduce their feeding efficiency and/or their vulnerability to predators.

4.3.2.1.7 Entrainment

Large numbers of fish are lost to the CVP and SWP water export facilities located in the south Delta. As an indication of the magnitude of entrainment effects caused by the Banks and Jones pumping plants, approximately 110 million fish were salvaged at the Skinner Fish Facility screens and returned to the Delta over a 15-year period (Brown et al. 1996). However, this number greatly underestimates the actual number of fish entrained (USFWS 2008a, p. 160). In addition, the CVP and SWP water export facilities and other diversions export phytoplankton, zooplankton, nutrients, and organic material that would otherwise contribute to supporting the base of the food web in the Delta (Jassby and Cloern 2000, p. 348; Resources Agency 2007, p. 21). In addition to the CVP and SWP water export facilities located in the south Delta and various smaller facilities, there are about 2,200 agricultural diversions in the Delta (Herren and Kawasaki 2001, p. 347). Diversions may also create conditions that increase the risk of predation by trapping fish in diversion forebays.

4.3.2.1.8 Contaminants

Contaminants have been identified as an important driver of declines in ecosystem function in the current Delta and Suisun Marsh. An unknown number of chemicals are introduced into the Delta from a variety of sources. These include point sources such as effluents from municipal and industrial wastewater treatment plants as well as urban, agricultural, and industrial nonpoint sources. The fate of contaminants in the estuarine ecosystem is complex, depending on interactions among transport, mixing, and residence times (Kuivila and Hladick 2008, p. 15). The types of contaminants thought to be present in the Delta with the potential to affect aquatic and terrestrial species include:

- Pesticides, both current use and residues of legacy pesticides
- Mercury and other heavy metals such as copper and nickel
- Selenium
- Polychlorinated biphenyls (PCB)
- Polycyclic aromatic hydrocarbons (PAH)
- “Emerging Pollutants” such as ammonium and endocrine disrupting chemicals (EDC)

Contaminant effects are generally species-specific. Pesticides and heavy metals are more likely to directly affect lower trophic levels, with potential negative effects on species composition and food web dynamics. At higher trophic levels, toxic effects are less likely to cause direct mortality, but sublethal toxicity may reduce ecological fitness through impaired growth, reproduction, or behavior, or by increasing the organism’s susceptibility to disease (Werner et al. 2008, p. 3).

4.3.2.1.9 Nitrogen Loading

There are currently many sources of nitrogen for the Delta and Suisun Marsh. Nitrogen can be found in several forms in the aquatic environment, with each form having different sources and each form having different implications for the Delta and Suisun Marsh ecosystem. Nitrogen as a nutrient (nitrate) fuels plant growth and thus over-enrichment can favor some species over others, changing the relative abundance of species. Nitrogen as ammonia can be toxic to fish and other aquatic organisms, even at very low concentrations (USEPA 1999). Nitrogen as ammonium can inhibit nitrate uptake by phytoplankton thus limiting primary and secondary productivity; this effect has been the subject of much recent investigation (Foe et al. 2010; Dugdale et al. 2007; Glibert 2010).

4.3.2.1.10 Other Water Quality Issues

The suitability of estuarine fish habitat is influenced by a number of dynamic water quality habitat attributes and stationary, structural habitat attributes (Peterson 2003, p. 299). Water quality parameters such as salinity, turbidity, temperature, dissolved oxygen concentration, and water and sediment-borne contaminants are locally important attributes of fish habitat.

Turbidity refers to the clarity of water and is influenced by factors such as suspended sediment, and particulate and dissolved organic matter, which in the Delta are influenced by river flows, tidal currents, wind events, and bathymetry (Ruhl et al. 2001, p. 802). Reduced turbidity may reduce foraging efficiency and increase the vulnerability of delta smelt and other fish species to predation. Feyrer et al. (2007, p. 729) determined that turbidity is a significant predictor of delta smelt occurrence in the Delta; delta smelt occurrence increases with higher turbidity.

Water temperature is an important determinant of fish metabolic and growth rates (Marine and Cech, 2004, p. 205), and affects estuarine habitat suitability through a variety of mechanisms. High water temperatures can lead to physiological stress and negatively affect salmonid growth rates, smoltification, and ability to escape from predators (Myrick and Cech, 2001; Marine and Cech 2004, p. 199). Temperature can also indirectly influence the incidence of disease and predation. High water temperatures are mainly a concern for salmonids in their upstream (outside the Delta) spawning and rearing grounds. However, high water temperatures in the Delta can negatively affect rearing salmonids and disrupt or

delay migration of both spawning adults and emigrating juvenile salmon and steelhead. High water temperature often increases fish sensitivity to low dissolved oxygen concentrations (Cech et al. 1990, p. 100). Stress experienced by rearing delta smelt during the warmer summer months may affect delta smelt survival, abundance, and subsequent reproductive success within the Bay-Delta estuary.

4.3.2.1.11 Climate Change

Global climate change is expected to increase sea levels and temperatures and affect local weather patterns. As sea level rises, intrusion of brackish water into the Delta is expected to increase; this intrusion of sea water would raise water surface elevations in the Delta, increasing the differential between water surface elevation in channels and land elevations on Delta islands. The land-water interface is predicted to move to higher elevations as a result of climate change induced sea level rise. The mean tide level is expected to move 12 to 18 inches above the current level by 2050 and 21 to 55 inches by 2100, increasing at an accelerating rate (California Natural Resources Agency 2009). In addition to sea level rise, climate change is also expected to increase the frequency, duration and height of flood flows, because of continued shifts in California precipitation away from snowfall to rain (California Natural Resources Agency 2009). This will further exacerbate, in winter, the impact of sea level rise on tidal marshes and riparian forest and scrub. In addition, precipitation models suggest a trend toward reduced precipitation in the future (California Natural Resources Agency 2009), which could influence the amount of water entering the Delta.

Effects of sea level rise on tidal marsh and riparian vegetation depend on the potential for sediment and organic accretion (material buildup), and on the opportunity for the marsh to expand land-ward, while the shoreline erodes (Orr et al. 2003). Substrate accretion in freshwater tidal marshes is expected to be able to keep pace with at least moderate levels of sea level rise due to organic accretion, but brackish and salt marshes are more dependent on sediment supply for accretion to keep pace with sea level rise (Orr et al., 2003; Callaway et al., 2007). Overall, a loss of tidal marshes is expected, because in many cases an opportunity for landward migration of the marsh does not exist. Global climate change also influences local climate conditions, particularly temperature and precipitation patterns, with implications for future inflows from tributaries to the Delta. With a warmer climate, atmospheric moisture will increase, resulting in more intense and warmer storms. This is expected to increase the size of winter floods (or their frequency) because of more precipitation in each storm and more moisture falling as rain rather than snow. Cumulatively, these changes are expected to put additional pressure on the Delta's fragile levees and increase the intrusion of brackish water into the Delta, with corresponding declines in both habitat and water quality.

In addition, modeling scenarios predict an increase in California's air. Because Delta water temperature is determined primarily by air temperature, an increase in water temperatures could exacerbate already poor conditions for native aquatic species that are particularly sensitive to water temperatures. Regional climate change also has the potential to increase the suitability of the Delta to invasions of new species and pathogens (e.g. West Nile virus).

4.3.2.2 Special-status Species

Special-status species are defined as species that are legally protected or otherwise considered sensitive by federal, State, or local resource agencies. Special-status species are species, subspecies, distinct population segments or varieties that fall into one or more of the following categories, regardless of their legal or protection status:

- Species officially listed by the State of California as threatened, endangered, or rare (plants only)
- Species officially listed by the federal government as threatened or endangered

- Candidates for State listing as threatened or endangered and species that are formally proposed for federal listing or that are candidates for listing as threatened or endangered
- Species that meet the definitions of rare, threatened, or endangered under California Environmental Quality Act (CEQA) (State CEQA Guidelines, section 15380)[2]
- Species identified by DFG as species of special concern and/or on DFG's Special Animals List (DFG 2011b) and species designated by statute as fully protected species (e.g., California Fish and Game Code, section 3511 [birds], 4700 [mammals], and 5,050 [reptiles and amphibians] and 5515 [fish])
- Species afforded protection or special consideration by local planning documents
- Species designated as sensitive by the California Board of Forestry, U.S. Forest Service, and/or Bureau of Land Management
- Species, subspecies, and varieties of plants considered by DFG and CNPS to be "rare, threatened, or endangered in California." The CNPS Inventory of Rare and Endangered Plants of California (CNPS Inventory) assigns California Rare Plant Rank (CRPR) categories for plant species of concern, which are summarized as follows[3]:
    - CRPR 1A—Plants presumed to be extinct in California
    - CRPR 1B—Plants that are rare, threatened, or endangered in California and elsewhere
    - CRPR 2—Plants that are rare, threatened, or endangered in California but more common elsewhere
    - CRPR 3—Plants about which more information is needed (a review list)
    - CRPR 4—Plants of limited distribution (a watch list). Plants in this category may not all be considered special-status plants.

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[2] (b) A species of animal or plant is:

(1) "Endangered" when its survival and reproduction in the wild are in immediate jeopardy from one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, disease, or other factors; or

(2) "Rare" when either:

(A) Although not presently threatened with extinction, the species is existing in such small numbers throughout all or a significant portion of its range that it may become endangered if its environment worsens; or

(B) The species is likely to become endangered within the foreseeable future throughout all or a significant portion of its range and may be considered "threatened" as that term is used in the Federal Endangered Species Act.

(c) A species of animal or plant shall be presumed to be endangered, rare or threatened, as it is listed in:

(1) Sections 670.2 or 670.5, Title 14, California Code of Regulations; or

(2) Title 50, Code of Federal Regulations Section 17.11 or 17.12 pursuant to the Federal Endangered Species Act as rare, threatened, or endangered.

(d) A species not included in any listing identified in subdivision (c) shall nevertheless be considered to be endangered, rare or threatened, if the species can be shown to meet the criteria in subdivision (b).

[3] These CRPR categories are the result of a collaborative effort of CNPS and DFG. The CRPR is based on reviews by numerous qualified botanical experts and provides a source of substantial evidence that is used by lead agencies to determine what plants meet the definition of endangered, rare, or threatened species, as described in section 15380 of the State CEQA Guidelines. For purposes of this document, the most relevant categories are CRPR 1B, 2, and 3.

All plants listed in the CNPS inventory are considered "special plants" by DFG. The term "special plants" is a broad term used by DFG to refer to all the plant taxa inventoried by the CNDDB, regardless of their legal or protection status. Notation as a CRPR 1B, 2, or 3 plant species does not automatically qualify the species as endangered, rare, or threatened within the definition of State CEQA Guidelines section 15380. Rather, CRPR designations are considered along with other available information about the status, threats, and population condition of plant species to determine whether a species warrants evaluation as an endangered, rare, or threatened species under CEQA. Plants with CRPR 1A, 1B, or 2 may qualify for listing, and DFG recommends—and local governments may require—that these species be addressed in CEQA projects. However, a plant species need not have a CRPR to be considered a rare, threatened, or endangered species under CEQA.

4.3.2.2.1 Special-status Plant Species

Information on 71 special-status plant species that occur, or that have the potential to occur in, the Delta or Suisun Marsh is presented in Appendix F-3. This species information includes: common and scientific names, listing status (federal, State, and CRPR), notes on the species' habitat, distribution in California, flowering period, and potential for occurrence in the Delta or Suisun Marsh. More detailed species accounts addressing 12 of the special-status plant species are provided in Appendix F-3, Special-status Plant Species Accounts. Detailed species accounts were prepared for those special-status plant species that have a CRPR of 1 or 2 and are known to occur, or are likely to occur based on their habitat association, in the Delta and Suisun Marsh and that could be affected by implementation of the Delta Plan.

The following text describes plant communities in the Delta and Suisun Marsh that have the potential to support the special-status plants identified in Table 4-1 (Tables 4-1 through 4-5 are attached at the end of this section).

Agricultural fields and ruderal areas are not expected to support special-status plant species because they have been converted from their natural vegetative cover to cover types that no longer provide habitat suitable for native plant species. Open water habitat in the Delta provides suitable habitat for eel grass pond weed. Two special-status plant species, Contra Costa wallflower and Antioch Dunes evening primrose, are known to occur on inland dunes habitat. Riparian scrub, forest, and woodland in the Delta provide suitable habitat for, and have the potential to support, five special-status plant species: bristly sedge, fox sedge, slough thistle, Delta button celery, and rose mallow.

Alkali habitats in the Delta and Suisun Marsh, including alkali wetlands and grasslands, provide suitable habitat for, and have the potential to support, 18 special-status plant species: recurved larkspur, alkali milkvetch, five species of Atriplex, two species of tarplant, slough thistle, two species of bird's beak, Contra Costa goldfields, little mousetail, hairless popcorn flower, Wright's trichocoronis, saline clover, and caper-fruited tropidocarpum.

Vernal pools in the Delta and Suisun Marsh provide suitable habitat for, 14 special-status plant species: dwarf downingia, Bogg's Lake hedge-hyssop, hogwallow starfish, Contra Costa goldfields, Ferris' goldfields, legenere, little mousetail, Baker's navarretia, Colusa grass, bearded popcorn flower, Delta woolly marbles, lobed buttercup, Wright's trichocoronis, and Solano grass.

Marshes and seasonal wetlands in the Delta and Suisun Marsh provide suitable habitat for, and have the potential to support, 15 special-status plant species: bristly sedge, fox sedge, slough thistle, soft bird's beak, small spikerush, rose mallow, Delta tule pea, Mason's lilaeopsis, Delta mudwort, Sanford's arrowhead, marsh skullcap, side-flowering skullcap, Suisun Marsh aster, water hemlock, and Suisun thistle.

Grasslands in the Delta and Suisun Marsh provide suitable habitat for, the largest number of special-status plant species of any habitat type present. The 27 species of special-status plants that could occur in grasslands are bent flowered fiddleneck, Ferris' milkvetch, big tarplant, Brewer's calandrinia, Mt. Diablo fairy lantern, bristly sedge, three species of tarplant, small-flowered morning glory, two species of bird's beak, Hoover's cryptantha, round-leaved filaree, diamond-petaled poppy, stinkbells, fragrant fritillary, Brewer's western flax, central coast iris, Carquinez goldenbush, Heckard's peppergrass, showy madia, cotulaleaf pincushionplant, Gairdner's yampah, two species of popcorn flower, and caper-fruited tropidocarpum.

4.3.2.2.2 Special-status Fish and Wildlife Species

Table 4-2 presents information on the special-status fish and wildlife species that occur, or that have the potential to occur in, the Delta or Suisun Marsh. The table provides the following information on the species: common and scientific names, listing status (federal, State, Global Rank, and/or State Rank), notes on the species habitat, and potential for occurrence in the Delta or Suisun Marsh. The following sections present detailed summaries of federally listed and State-listed invertebrates, amphibians, reptiles, fish, birds, and mammals that occur, or with potential to occur in, the Delta or Suisun Marsh. More detailed species accounts addressing the special-status fish and wildlife species are provided in Appendix F-4, Special-status Fish and Wildlife Species Accounts. Detailed species accounts were prepared for those special-status fish and wildlife species that are known to occur, or are likely to occur, in the Delta or Suisun Marsh and that could be affected by implementation of the Delta Plan.

Invertebrates

The federally listed or State-listed invertebrates that may occur in the Delta or Suisun Marsh are Lange's metalmark butterfly, valley elderberry longhorn beetle, Conservancy fairy shrimp, longhorn fairy shrimp, vernal pool fairy shrimp, and vernal pool tadpole shrimp.

Lange's Metalmark Butterfly

Lange's metalmark butterfly is federally listed as endangered. All life stages of this butterfly are found close to its larval food plant: nude buckwheat. This is the only plant on which the larvae are known to feed (USFWS 2008b). Adults use a variety of other plants to obtain nectar and for mating. Historically, Lange's metalmark butterfly was restricted to sand dune habitat along the southern bank of the Sacramento–San Joaquin River confluence, but today it is found only at the Antioch Sand Dunes in Contra Costa County, where most of the habitat is part of the Antioch Dunes NWR and is managed to conserve this species.

Valley Elderberry Longhorn Beetle

Valley elderberry longhorn beetle is federally listed as threatened. It requires elderberry shrubs and is generally associated with riparian habitats. Valley elderberry longhorn beetle is threatened by loss and fragmentation of riparian habitat and by predation and displacement by the invasive Argentine ant (Huxel 2000). There are three known occurrences of this beetle in the Delta: two from Yolo County in or immediately south of West Sacramento and one from San Joaquin County, approximately 1 mile north of Old River. Suitable habitat exists throughout the Delta, with the highest concentrations of shrubs in the north Delta.

Conservancy Fairy Shrimp

Conservancy fairy shrimp is federally listed as endangered. It occurs in turbid vernal pools ranging from large, playa-type vernal pools to long-inundation, smaller vernal pools (Eng et al. 1990; USFWS 2007a). The Conservancy fairy shrimp is threatened primarily by habitat loss and fragmentation resulting from expansion of agricultural and developed land. It is known to occur in the Delta in Yolo County and at the western edge of the Delta in Solano County. Turbid-water playas and vernal pools that may support the species occur on alkaline soils from the DFG Tule Ranch Reserve southwest to the Montezuma Wetlands Mitigation Project, and from the Byron Airport northwest to Discovery Bay.

Longhorn Fairy Shrimp

Longhorn fairy shrimp is federally listed as endangered. Occurrences are rare and widely separated, with specific pool characteristics largely unknown (USFWS 2005, 2007b). The longhorn fairy shrimp has likely experienced habitat loss and fragmentation as a result of expanding agriculture and developed land. However, it is now threatened by habitat loss and disturbance resulting from several site-specific activities at the few locations from which it is known: wind energy development, a water storage project,

construction of a dirt access road, and land management activities (USFWS 2005). It has been recorded from vernal pool grasslands near Byron Airport in the extreme southwest of the Delta. The known populations closest to the Delta are in Contra Costa County (Vasco Caves Preserve) and Alameda County (Brushy Peak Preserve). These occurrences are in seasonal pools that fill sandstone depressions in rocky outcrops, habitats that are not present anywhere in the Delta. This species also occurs in pools in alkali sink vegetation in other parts of its known range (USFWS 2005, 2007b; CNDDB 2011), although 14 years of surveys have not detected longhorn fairy shrimp in similar pools in the Delta (USFWS 2005, 2007b).

Vernal Pool Fairy Shrimp

Vernal pool fairy shrimp is federally listed as threatened. It inhabits primarily vernal pools (Eng et al. 1990) but also occurs in other wetlands that provide habitat similar to vernal pools: alkaline rain-pools, ephemeral drainages, rock outcrop pools, ditches, stream oxbows, stock ponds, vernal swales, and seasonal wetlands (Helm 1998); it has also been detected in disturbed vernal pools. It is threatened primarily by habitat loss and fragmentation resulting from the expansion of agricultural and developed land. The vernal pool fairy shrimp is known to occur in suitable habitat in and near the Delta—specifically, in grasslands near Clifton Court Forebay in the north, and in the west in Solano County.

Vernal Pool Tadpole Shrimp

Vernal pool tadpole shrimp is federally listed as endangered. It occurs in a wide variety of seasonal habitats: vernal pools, ponded clay flats, alkaline pools, ephemeral stock ponds, and roadside ditches (CNDDB 2011; Helm 1998; Rogers 2001). Habitats where vernal pool tadpole shrimp have been observed range in size from small, clear, vegetated vernal pools to highly turbid pools and large winter lakes (Helm 1998; Rogers 2001). The vernal pool tadpole shrimp is threatened primarily by habitat loss and fragmentation resulting from the expansion of agricultural and developed land. It is known to occur in suitable habitat in grasslands in the western Delta in Yolo and Solano counties and at the eastern edge of the Delta in Sacramento County.

Other Special-status Invertebrates

Twenty-two other special-status invertebrates could occur in the Delta and be affected by implementation of the Delta Plan. These species and their habitat relationships are presented in Table 4-2. These species are not State listed or federally listed but are sufficiently rare to be tracked in the California Natural Diversity Database (CNDDB) by DFG. The species known primarily from sandy dune and/or riparian habitats are Antioch Dunes anthicid beetle, Sacramento anthicid beetle, redheaded sphecid wasp, Middlekauff's shieldback katydid, Hurd's metapogon robberfly, and Antioch andrenid bee. The species associated with vernal pools and surrounding grasslands are Blennosperma vernal pool andrenid bee, midvalley fairy shrimp, California linderiella, and molestan blister beetle. The curved-foot hygrotus diving beetle occurs in small seasonal pools associated with alkaline plant communities. The Bridges' Coast Range shoulderband snail occurs in grasses and weeds on open hillsides. Ricksecker's water scavenger beetle occurs in ponds, but habitat associations are poorly understood. The habitat associations of Antioch efferian robberfly are unknown. Two species are presumed extinct: Sacramento Valley tiger beetle and Antioch multilid wasp.

Amphibians

Federally listed or State-listed amphibians that may be present in the Delta are California tiger salamander and California red-legged frog.

California Tiger Salamander

California tiger salamander is federally listed as threatened in the Central Valley and is State listed as threatened. It requires vernal pools, ponds (natural or human made), or semipermanent calm waters (where ponded water is present for at least 10 to 12 weeks) for breeding and larval maturation. It also

requires adjacent upland areas that contain small-mammal burrows or other suitable refugia for aestivation (summer dormancy). Primary threats to California tiger salamander include the alteration of either breeding ponds or upland habitat through the introduction of exotic predators (e.g., bullfrogs) or the construction of barriers that fragment habitat and reduce connectivity (e.g., roads, berms, and certain types of fences). California tiger salamander occurs in greatest abundance in and near the southwest Delta in the vicinity of Byron Airport. It has also been recorded in the western Delta in Solano County and in the eastern Delta in southern San Joaquin County.

California Red-legged Frog

California red-legged frog is federally listed as threatened and is a California species of special concern. It uses ponds, stream courses, permanent pools, and intermittent streams (Hayes and Jennings 1988; USFWS 2002). The most significant threats to the California red-legged frog are habitat loss and alteration, introduced predators, water management, mismanagement of grazing livestock, chemical contamination from urban and industrial runoff, and extended drought conditions. California red-legged frogs have been recorded on creeks, canals, and seasonal ponds in and within several miles of the Delta near Clifton Court Forebay.

Other Special-status Amphibians

One other special-status amphibian, western spadefoot, could occur and be affected by implementation of the Delta Plan. This species is associated with vernal pools and adjacent grasslands; additional information is presented in Table 4-2.

Reptiles

Giant Garter Snake

Giant garter snake is federally listed and State listed as threatened. This species resides in marshes, ponds, sloughs, small lakes, low-gradient streams, and other waterways and agricultural wetlands, including irrigation and drainage canals, rice fields, and the adjacent uplands (58 FR 54053). Giant garter snake is threatened primarily by habitat conversion, fragmentation, and degradation resulting from urban development (58 FR 54053 to 54065) (Dickert 2003). Giant garter snakes are sparsely distributed north of State Route (SR) 4 in the central and northern Delta. With the exception of recent occurrences from the Yolo Bypass, Cosumnes River Preserve, and White Slough WA, most of these records are from the mid-1980s (CNDDB 2011).

There are no records of species occurrence south of SR-4. Records suggest that giant garter snakes may have occupied this region, but conversion of wetlands for agriculture has eliminated most suitable habitat (Hansen 1986; CNDDB 2011). Scattered records in the central Delta north of SR-4 suggest that giant garter snakes may have occupied this region at one time, but longstanding reclamation of wetlands for intense agricultural applications has eliminated most suitable habitat (Hansen 1986; CNDDB 2011). Recent records in the central Delta are haphazard, and repeated surveys at focused locations in the central Delta have failed to identify any extant population clusters in the region (Hansen 1986; Patterson and Hansen 2002; Patterson 2005). Recent surveys indicate that giant garter snake could potentially be found in other areas in or near the Delta (Hansen 2007; Wylie et al. 2003; Wylie et al. 2004; Wylie and Amarello 2006). Four individuals were documented on western Empire Tract in 2010 (USFWS 2010a), and one was documented from Grizzly Island in the Suisun Marsh (Hansen 2011). Surveys in 2008 and 2009 (CNDDB 2011) also demonstrated that giant garter snake is extant in or near the Delta at the White Slough WA, in Badger Creek/Willow Creek (at the Cosumnes River Preserve), and in the Yolo Bypass. The White Slough WA population is considered to be a geographically and genetically unique population (Hansen 2009). There is concern that isolated populations may be subject to greater risk of extirpation (USFWS 2006a).

Other Special-status Reptiles

Four other special-status reptiles may occur in the Delta and Suisun Marsh and be affected by implementation of the Delta Plan. Silvery legless lizard, San Joaquin whipsnake, and California horned lizard are associated with a variety of mostly open upland habitats. These species and their habitat relationships are presented in Table 4-2. Western pond turtle is a State species of special concern. It uses still or slow-moving waters in streams, sloughs, ponds, marshes, and irrigation ditches. It needs basking sites and suitable upland habitat, such as sandy banks or grassy open fields, for egg-laying. Threats include habitat loss, competition with introduced species, and off-road vehicles. Western pond turtle occurs in suitable habitat throughout the Delta and Suisun Marsh.

Special-status Fish Species

Special-status fish species found in the study area include both resident fish species (those that spend their entire life cycle in the Delta and/or Suisun Marsh) and anadromous species (fish that spawn and rear in fresh water. Several native species of anadromous fishes, including Chinook salmon; steelhead, sturgeon, and longfin smelt occur within the legal Delta and Suisun Bay. Anadromous fish, such as Chinook salmon and steelhead, typically use the Delta and Suisun Bay as migratory corridors to upstream spawning areas and for juvenile rearing en route to the ocean, although sturgeon (particularly green sturgeon) and longfin smelt may spend a considerable amount of their lifetime in the Delta and Suisun Marsh areas. Habitat for the primarily marine/estuarine fish such as northern anchovy and starry flounder is described in a section following the description of fish species.

Delta Smelt

Delta smelt are federally listed as threatened and listed as endangered by the State of California. Critical habitat for delta smelt has been designated. Delta smelt spawn in the freshwater reaches of the San Francisco estuary, primarily in the Delta. After hatching, larvae disperse into low salinity habitats, generally moving into Suisun Bay, Montezuma Slough, and the lower Sacramento River below Rio Vista as they mature (Grimaldo et al. 1998, p. 27). In general, delta smelt prefer to rear in or just above the region of the estuary where fresh water and brackish water mix as a result of tidal and river currents; this region is typically in Suisun Bay (Bennett 2005, p. 11). Primary threats to delta smelt include loss of habitat and reductions in the quality of their habitat; entrainment in the CVP and SWP water export facilities and other adverse effects from CVP/SWP operations, and other water diversions in the Delta; the introduction of nonnative species; and toxic chemicals such as agricultural pesticides, herbicides, heavy metals, and other agricultural and urban discharges into the Delta.

Sacramento Splittail

Sacramento splittail are not listed under the State or federal ESA, but are considered a California species of special concern. Sacramento splittail is endemic to the sloughs, lakes, and rivers of the Central Valley. In the Sacramento River basin, the most important spawning areas appear to be the Yolo and Sutter bypasses, which are extensively flooded during wet years (Sommer et al. 1997, p. 970-972; 2001a, p. 11). In the San Joaquin drainage, spawning apparently takes place in wet years where the San Joaquin River is joined by the Tuolumne and Merced rivers (Moyle et al. 2004, p. 15). Threats to Sacramento splittail include habitat loss and degradation, loss of access to seasonally inundated floodplains, introduction of nonnative species, entrainment in the CVP and SWP water export facilities, and harvest by recreational anglers.

Hardhead

Hardhead are not listed under the State or federal ESA, but are considered a California species of special concern. Hardhead is a native species that is widely distributed in low to mid-elevation streams in the Sacramento and San Joaquin drainages. Although hardhead is still fairly common, populations are generally in decline, similar to other California native species (Moyle 2002, 154). The cause of this decline appears to be habitat loss and predation by nonnative fishes.

Chinook Salmon

Several listed Evolutionarily Significant Units (ESU) of Chinook salmon use the Delta during one or more of their life history stages. Declining population numbers and continuing threats to salmon populations have resulted in the listing of several Chinook salmon populations under the federal and State ESAs. Critical habitat for these populations generally includes their natal streams and migration corridors and rearing areas in the Delta and Suisun Marsh. Chinook salmon pass through the Delta as juveniles emigrating to the ocean from the Sacramento and San Joaquin rivers and tributaries where they were born, and again as adults on their return migration to their natal streams to spawn. Young salmon use the Delta, Suisun Marsh, and the Yolo Bypass (when flooded) for rearing to varying degrees, depending on their life stage (fry vs. juvenile) and size, river flows, and time of year.

Access to most of the historical upstream spawning habitat for Chinook salmon and steelhead has been eliminated or degraded by manmade structures (e.g., dams and weirs) associated with water storage, conveyance, flood control, and diversions and exports for municipal, industrial, agricultural, and hydropower purposes (Yoshiyama et al. 1998, p. 500; McEwan 2001, p. 15; Lindley et al. 2006, p. 2). Continued threats to Chinook salmon include loss and degradation of habitat available for spawning and juvenile rearing; predation on juvenile salmon by nonnative fish; entrainment at the SWP and CVP export facilities and other adverse effects from CVP/SWP operations, and other water diversions in the Delta; exposure to pesticides and herbicides; illegal harvest; climate change, and interactions with hatchery-produced salmon.

Steelhead

The Central Valley and Central California Coast Distinct Population Segments (DPS) of steelhead are federally listed as threatened. Critical habitat for Central Valley steelhead DPS has been designated within specified stream reaches in Tehama, Butte, Glenn, Shasta, Yolo, Sacramento, Solano, Yuba, Sutter, Placer, Calaveras, San Joaquin, Stanislaus, Tuolumne, Merced, Alameda, and Contra Costa counties (70 FR 52488). Critical habitat for Central California Coast steelhead DPS has been designated within specified stream reaches in Lake, Mendocino, Sonoma, Napa, Marin, San Francisco, San Mateo, Santa Clara, Santa Cruz, Alameda, Contra Costa, and San Joaquin counties (70 FR 52488). Spawning takes place in small headwater streams and tributaries where cool, well oxygenated water is available year-round (Hallock et al. 1961, p. 16; McEwan and Jackson 1996, p. 19). Emigrating steelhead use the lower reaches of the Sacramento River and the Delta for rearing and as a migration corridor to the ocean. Some juvenile steelhead may rear in tidal marsh areas, and connected non-tidal freshwater marshes and other shallow water areas in the Delta for short periods prior to their final emigration to the ocean (NMFS 2009, p. 106). Threats to steelhead are similar to those described for Chinook salmon.

Green Sturgeon

The southern DPS of green sturgeon is federally listed as threatened. Critical habitat for this green sturgeon DPS has been designated and includes the Sacramento River, lower Feather River, and lower Yuba River; and the Sacramento-San Joaquin Delta and Suisun, San Pablo, and San Francisco bays (74 FR 52300). Green sturgeon spend a large portion of their lives in coastal marine waters as subadults and adults. Adults and subadults occupy the San Francisco Bay, San Pablo Bay, Suisun Bay, and the Delta adjacent to the Sacramento River. Adults and subadults primarily inhabit the Delta and bays during summer months, most likely for feeding and growth (Kelly et al. 2007, p. 292).

As with the anadromous salmonids, access to historical spawning habitat for green sturgeon has been reduced by construction of migration barriers, such as major dams, that block or impede access. The Red Bluff Diversion Dam (RBDD) is a major impediment to sturgeon migration on the Sacramento River. Other threats to green sturgeon include loss and degradation of rearing habitat; dredging operations in the Sacramento and San Joaquin rivers, and the navigation channels within the Delta, and Suisun, San Pablo, and San Francisco bays; illegal harvest; and contaminants.

Longfin Smelt

Longfin smelt are listed as threatened by the State of California. Longfin smelt is a candidate for listing as an endangered species under CESA and is protected by the take prohibition of that statute. In 2009, the USFWS issued a 12-month finding concluding that the Delta population of longfin smelt did not meet the definition of a distinct population segment, and therefore did not qualify for listing under the federal ESA. Under the terms of a court settlement, the USFWS must conduct a range-wide review of the species and issue a new listing determination by September 30, 2011. No critical habitat for this species has been designated.

In California, longfin smelt are known from the Klamath River, Humboldt Bay and its tributaries, the Eel River, the Van Duzen River, the Russian River, and the San Francisco Bay-Delta (Moyle 2002, p. 235-236). During its life cycle, longfin smelt use the entire estuary from the freshwater Delta downstream to South San Francisco Bay and out into coastal marine waters (Baxter 1999, p. 180; Moyle 2002, p. 236; Rosenfield and Baxter 2007, p. 1590). Spawning usually occurs over rocky or gravelly substrates and aquatic plants (Moyle 2002, p. 236). Newly hatched embryos are transported in the upper portion of the water column downstream (west) into more brackish parts of the Bay-Delta system (Moyle 2002, p. 236). Due to their similarity in habitat use, longfin smelt are subject to many of the same stressors and population threats as delta smelt (see discussion above).

River Lamprey

The river lamprey is not listed under the federal or State ESA, but is considered a species of special concern by the State of California. The species is more abundant in the lower Sacramento-San Joaquin River system than in other streams in California, but few surveys for river lamprey have been conducted (Moyle 2002, p. 102). The river lamprey is anadromous; adults enter freshwater in the fall and move upstream to suitable spawning areas with perennial water. It is thought that adults need clean, gravelly riffles in permanent streams to spawn successfully. Adults die after spawning. The eggs hatch into ammocoetes that remain in freshwater for approximately 3 to 5 years. The ammocoete stage requires high quality, perennial backwaters or stream edges over a sandy substrate, into which they bury in the sediments and feed on algae and microorganisms (Moyle et al. 1995, p. 23). The ammocoetes begin to transform into adults during the summer. This process takes 9 to 10 months, and the new adults enter the ocean in late spring. Adults spend approximately 3 to 4 months in the ocean where they grow rapidly. In the ocean, adult river lampreys are parasitic, feeding on a variety of host fish species including herring and salmon (Moyle 2002, p. 102).

The primary threats to anadromous lampreys, including river lamprey, are loss or degradation of habitat through dams, diversions, pollution, stream channelization, and urbanization (Moyle et al. 1995, p. 24; Luzier et al. 2009, p. 13 Table 1).

Marine Fish

A number of marine fish species managed under the Coastal Pelagic Fishery Management Plan or the Groundfish Fishery Management Plan have designated essential fish habitat. None of these species are found in the Delta and only northern anchovy and starry flounder are abundant in Suisun Bay (NMFS 2011). Essential fish habitat for the northern anchovy (and other coastal pelagic species) includes all marine and estuarine waters from the shoreline along the coasts of California, Oregon, and

Washington offshore to the limits of the exclusive economic zone and above the thermocline where sea surface temperatures range between 10ºC to 26ºC (PFMC 1998, p. D-2). The overall extent of essential fish habitat for starry flounder (and other groundfish species) includes all waters and substrate with depths less than or equal to 3,500 m (1,914 fathoms) to mean higher high water level or the upriver extent of saltwater intrusion, defined as upstream and landward to where ocean-derived salts measure less than 0.5 parts per thousand (ppt) during the period of average annual low flow (PFMC 2008, p. 62). Both of these "definitions" of essential fish habitat include areas within Suisun Bay and downstream though San Francisco Bay and into the marine environment.

Birds

Federally listed or State-listed birds that may occur in the Delta and Suisun Marsh include Swainson's hawk, western snowy plover, western yellow-billed cuckoo, white-tailed kite, greater sandhill crane, California black rail, California brown pelican, California clapper rail, bank swallow, California least tern, and least Bell's vireo.

Swainson's Hawk

Swainson's hawk is State listed as threatened. In the Central Valley, Swainson's hawks usually nest in large native trees, such as valley oak, cottonwood, walnut, and willow and occasionally nest in nonnative trees, such as eucalyptus. Nests occur in riparian woodlands, roadside trees, trees along field borders, isolated trees, and small groves and on the edges of remnant oak woodlands. Stringers of remnant riparian forest along drainages contain most of the known nests in the Central Valley (Estep 1984; Schlorff and Bloom 1984; England et al. 1997). This appears to be a function of the availability of nest trees, however, instead of a dependence on riparian forest. Swainson's hawks are essentially plains or open-country hunters, requiring large areas of open landscape for foraging. With substantial conversion of these grasslands to farming operations, Swainson's hawks have shifted their nesting and foraging into agricultural lands that provide low, open vegetation and high rodent prey populations. Alfalfa is particularly important foraging habitat for Swainson's hawk because its low structure and high prey densities allow for successful small-mammal hunting throughout the breeding season. Other crops do not provide constant foraging habitat but are important at certain periods—for example, during the premigratory period when fields are being harvested or tilled and vertebrate and invertebrate prey are accessible. Swainson's hawks that breed in California migrate to wintering grounds in Mexico and South America, although a small population (approximately 30 birds) has been documented as overwintering in the Delta (Herzog 1996). Threats to Swainson's hawk include loss and fragmentation of foraging habitat, loss of nesting habitat, disturbance of nests, and pesticide poisoning in wintering habitat (Anderson et al. 2005). A fairly dense nesting population has been recorded in the Delta north of SR-12 and south of SR-4.

Western Snowy Plover

Western snowy plover is federally listed as threatened and is a State species of special concern. In the interior of California, western snowy plovers breed on flat, barren to sparsely vegetated land, often on the shores of alkaline and saline lakes, such as those found in the southern San Joaquin Valley and east of the crest of the Sierra Nevada. They will also breed next to agricultural and wastewater treatment ponds. They breed irregularly in the Central Valley, including several historic (1960s to 1970s) and more recent (1998, 2006) breeding records from Yolo County, including from the Yolo Bypass WA in 2006 (Shuford et al. 2008). Western snowy plover forage on terrestrial and aquatic invertebrates. Threats to western snowy plover include human-caused changes of water levels during the breeding season, elevated levels of heavy metals, and disturbance at nest sites.

Western Yellow-billed Cuckoo

Western yellow-billed cuckoo is State listed as endangered and a candidate for federal listing. It nests and roosts in densely foliaged deciduous trees and shrubs found in valley, foothill, and desert riparian woodlands. It prefers areas with openings and dense, scrubby vegetation, such as those often associated with waterways, and avoids densely forested and large urban areas (Hughes 1999). In California, the western yellow-billed cuckoo is considered a neotropical migrant. Western populations suffered catastrophic range reductions in the 20th century because of loss of riparian habitat through clearing for agriculture, flood control, and urbanization. In California, the western yellow-billed cuckoo once numbered more than 15,000 pairs, but the population has been reduced to approximately 30 pairs in less than 100 years because of the destruction of preferred riparian habitat and pesticide use (Hughes 1999). In the Central Valley, the western yellow-billed cuckoo is a rare summer resident at isolated sites in the Sacramento Valley. It has been occasionally documented in Colusa, Glenn, Butte, Sutter, and Yolo counties within the last 20 years.

White-tailed Kite

White-tailed kite is a State fully protected species. It nests in trees and shrubs in grasslands, oak woodlands, savannas, and riparian scrub throughout the Delta. Preferred foraging habitats include wetlands and grasslands, particularly herbaceous lowlands with minimal shrub and tree growth. The primary threats to the white-tailed kite are habitat loss, fragmentation, and degradation (Dunk 1995). In the Central Valley, loss of nest trees and human disturbance of nest sites have degraded habitat.

Greater Sandhill Crane

Greater sandhill crane is State listed as threatened and is a fully protected species. In California, it nests mostly in the northeastern part of the state, usually in open, grazed meadows. In the Central Valley, it winters almost entirely in agricultural fields and edges. Wintering habitat consists of three primary elements: foraging habitat, loafing habitat, and roosting habitat. In the Delta, harvested cornfields are the most commonly used foraging habitat, along with winter wheat, alfalfa, pasture, and fallow fields (Littlefield and Ivey 2000). Greater sandhill cranes usually loaf in midday along agricultural field borders, levees, rice-checks, and ditches or in alfalfa fields or pastures. Nighttime roost sites are typically located 2 to 3 miles from foraging and loafing areas, usually in shallowly flooded, open fields of variable size (1 to 300 acres) or wetlands interspersed with uplands. Threats on the wintering grounds include changes in water availability; flooding fields for waterfowl, which reduces foraging habitat for cranes; conversion of cereal cropland to vineyards or other incompatible crop types; human disturbances; collision with power lines and other structures; disease; and urban encroachment (Littlefield and Ivey 2000).

Greater sandhill cranes begin arriving in the Delta in October, and the population peaks in December and January as cranes arrive from the Butte Basin. An estimated two-thirds (5,000 to 6,000 cranes) of the population resides in the Delta for the remainder of the winter (Littlefield and Ivey 2000). Although populations have shifted over the years in response to changing agricultural patterns, particularly the increase of vineyards, the islands and tracts traditionally receiving the highest crane use include Staten Island, Terminous Island, Canal Ranch, and New Hope Tract. Other areas that receive occasional-to-regular use are Bouldin Island; Empire Tract; King Island; Grand Island; Tyler Island; Ryer Island; Brannan Island; Twitchell Island; Bradford Island; Venice Island; Manderville Island; and Webb, Holland, and Palm tracts (Pogson 1990; Littlefield and Ivey 2000). The Cosumnes River floodplain, much of it protected in The Nature Conservancy’s Cosumnes River Preserve, also supports substantial winter use by sandhill cranes. Use may have increased in this area because continued conversion of Delta islands to vineyards has reduced habitat availability (Littlefield and Ivey 2000).

California Black Rail

California black rail is State listed as threatened and is a fully protected species. It inhabits tidal saltwater and brackish marshes and freshwater marshes (Grinnell and Miller 1944; Manolis 1978). It prefers coastal areas with tidal salt marshes dominated by dense pickleweed with an open structure below. Pickleweed provides a dense canopy for protective cover, and California black rail seeks nesting habitat below the canopy. Throughout its range, the primary threat to California black rail is the loss and fragmentation of habitat from urbanization, flood control projects, agricultural practices, and hydrologic changes that affect water regimes. The most significant historical threat was the draining of tidal marshes, which may be responsible for more than 90 percent of the population decline of this species. Surveys conducted by DFG in the early 1990s found small numbers of California black rail at several locations in the central Delta, including White, Little Potato, Disappointment, and Whiskey sloughs; the mid-channel islands in Middle and San Joaquin rivers; the Holland and Palm tracts; and Mildred, Bacon, and Mandeville islands (CNDDB 2011). Most occurrences of California black rail have been on in-stream islands greater than 15 acres that support marsh vegetation elevated above the high tide and wave line (National Audubon Society 2009). Overall, Delta habitat availability is restricted to remnant wetland sites that are generally unavailable for agricultural uses.

California Brown Pelican

California brown pelican was delisted as a federally endangered species by the USFWS in 2009, but is a California fully protected species. California brown pelican could forage and roost in the Delta and Suisun Marsh, especially near deep water and on available roost sites near water deep enough to allow them to forage. The California brown pelican usually forages over estuarine, marine subtidal, and marine pelagic waters. These pelicans depend on anchovies and sardines, and threats can include overfishing and climate change, both of which can affect these prey species. Additional threats include oil spills, entanglement with hooks and fishing line, and disease outbreaks from overcrowding. Historically, the biggest threat to brown pelicans was the pesticide DDT, which led to the federal listing of the species as endangered in 1970. Following the ban of DDT in 1972, the species recovered substantially and was delisted on the Atlantic coast by 1985. According to USFWS, brown pelicans have also recovered in California (USFWS 2008c).

California Clapper Rail

California clapper rail is listed as endangered under the federal ESA and CESA. Critical habitat has not been designated for this species. It inhabits tidal and brackish marshes mostly west of Suisun Bay. Throughout their distribution, California clapper rails occur within a range of salt and brackish marshes but typically inhabit salt marshes dominated by pickleweed and Pacific cordgrass. In the Suisun Marsh, California clapper rails live in tidal brackish marshes that vary substantially in vegetation structure and composition. Use of brackish marshes by California clapper rails is largely restricted to major sloughs and rivers of San Pablo Bay and the Suisun Marsh and along Coyote Creek in south San Francisco Bay. California clapper rails have rarely been recorded in nontidal marsh areas (USFWS 2010b). Small tidal channels with dense vegetation covering the banks provide important foraging habitat and hidden routes for travel close to nesting. Higher marsh areas (high marsh and transitional zones) with dense vegetation are used for nesting and high-tide refugia habitat (USFWS 2010c). California clapper rails are relatively indiscriminate in their choice of nesting substrate and prefer to use the tallest cover regardless of plant in the upper-middle tidal marsh plain or high tidal marsh zones, but not upland habitat transition zones bordering tidal marsh (USFWS 2010c). Although California clapper rails have been consistently detected in the Suisun Marsh area, abundance has been low (USFWS 2010c; DFG 2008b, as cited in USFWS 2010c).

Bank Swallow

Bank swallow is State listed as threatened. It is a neotropical migrant that winters in South America. Bank swallows nest in burrows they dig in nearly vertical banks or cliff faces composed of soft soils. Suitable banks for nesting also must be more than 3 feet above the ground or water to avoid predators. They forage over a variety of land cover types (Garrison 1999; DFG 2005). The greatest threat to the bank swallow has been loss of breeding sites as a result of conversion of rivers and natural waterways to concrete-lined flood control channels (in Southern California) and the application of riprap to natural riverbanks in the Central Valley (DFG 2000a, 2005). Other threats come from predators that have access to colonies, changes in gravel and sand mining operations that destroy or no longer create nesting habitat, and high spring floods that can scour out colonies along riverbanks (Garrison 1999). This species has been documented nesting in the Delta along Sevenmile Slough near its confluence with Threemile Slough, and it could occur elsewhere in suitable habitat in the Delta.

California Least Tern

California least tern is federally listed and State listed as endangered. It prefers to nest on open or sparsely vegetated sandy or gravelly shores on beaches or near shallow-water estuaries where it often feeds. Although it prefers undisturbed sites, it has reportedly also nested on landfills and paved areas (CNDDB 2011). California least tern lives along the coastline and migrates north into California to nest from April to May. Its range along the Pacific coast generally extends from San Francisco to Baja California, and it overwinters in Mexico. When feeding, it follows schools of fish and is sometimes seen as far north as southern Oregon. California least tern feeds primarily in shallow estuaries or lagoons where small fish are abundant. Feeding also takes place near shore in the open ocean (Cogswell 1977, as cited in Zeiner et al. 1990), especially where lagoons are nearby, or at mouths of bays. Although this species is listed as endangered, its population numbers have increased from 600 pairs in 1973 to roughly 7,100 pairs in 2005, and USFWS believes it should now be relisted as threatened (USFWS 2006b, 2007c). California least tern is known to occur in the Suisun Marsh.

Least Bell's Vireo

Least Bell's vireo is federally listed and State listed as endangered. It nests and roosts in low riparian thickets of willows and shrubs, usually near water, but sometimes along dry, intermittent streams. Besides willows, other associated vegetation includes cottonwood trees, mulefat, blackberry, and mesquite (in desert). Least Bell's vireo was formerly a common and widespread summer resident throughout the Sacramento and San Joaquin valleys and in the coastal valleys and foothills from Santa Clara County south, but its numbers have drastically declined, and the species has vanished from much of its California range. Least Bell's vireo does not breed in the study area, but at least two pairs (two singing males with females) were observed at the Yolo Basin WA throughout the nesting season in 2010 (Whisler 2011).

Other Special-status Birds

Thirty-three other special-status birds could occur in the Delta and Suisun Marsh and be affected by implementation of the Delta Plan. These species and their habitat relationships are presented in Table 4-2. Species that nest in colonies in wetlands or riparian areas include tricolored blackbird (which may also nest in uplands and agricultural fields), white-faced ibis, yellow-headed blackbird, great egret, great blue heron, snowy egret, and double-crested cormorant. Species that nest in wetlands or riparian habitats include yellow warbler, yellow-breasted chat, saltmarsh common yellowthroat, song sparrow, and least bittern. Species that nest in upland grasslands or barren lands include grasshopper sparrow, California horned lark, and loggerhead shrike. Special-status nesting raptors include Cooper's hawk, burrowing owl, short-eared owl, northern harrier, and osprey. Species that nest outside of the Delta and Suisun Marsh but spend at least some portion of the year there include tule greater white-fronted goose, redhead, bald eagle, golden eagle, ferruginous hawk, mountain plover, merlin, American peregrine falcon, prairie falcon, lesser sandhill crane, and purple martin.

Mammals

Federally listed or State-listed mammals that would potentially be affected by implementing the Delta Plan include riparian woodrat, salt marsh harvest mouse, riparian brush rabbit, and San Joaquin kit fox.

Riparian Woodrat

Riparian woodrat is federally listed as endangered. This species of woodrat is most numerous where shrub cover is dense. The riparian woodrat is mostly active at night and feeds on leaves, fruits, terminal shoots of twigs, flowers, nuts, and fungi. The young are born in stick nest houses called lodges that are positioned over or against logs. The highest densities of lodges are often encountered in riparian willow thickets with an oak overstory consisting of deciduous valley oaks and few live oaks. Unlike other subspecies, the riparian woodrat occasionally builds nests in tree cavities and artificial wood duck nest boxes. Before the statewide reduction of riparian communities, the riparian woodrat probably ranged throughout the extensive riparian forests along major streams flowing onto the floor of the northern San Joaquin Valley (USFWS 2008d). Today, riparian woodrat populations are greatly depleted, with the only known population at Caswell Memorial State Park on the Stanislaus River, at the confluence with the San Joaquin River. Potential threats to this species and any unknown populations include habitat conversion to agriculture, wildfire, disease, predation, flooding, drought, clearing of riparian vegetation, use of rodenticides, and browsing and trampling by ungulates. Little potential habitat for riparian woodrat is present in the Delta at this time.

Salt Marsh Harvest Mouse

Salt marsh harvest mouse is federally listed and State listed as endangered. It primarily uses pickleweed in salt marsh habitats as long as it has nonsubmerged, salt-tolerant vegetation for escape during the highest tides. Loss and degradation of tidal marsh habitats continues to be the most significant threats to the salt marsh harvest mouse and other tidal marsh species. Other factors associated with declining populations include the conversion of salt marshes to brackish marshes because of freshwater discharges from sewage treatment plants; introduction of nonnative cordgrass, bulrush, saltgrass, and other plant species; predation by nonnative red foxes and feral cats; and runoff from industrial discharges and sewage effluent (Shellhammer et al. 1982, as cited in LSA 2007; DFG 2000b, as cited in LSA 2007). Salt marsh harvest mouse is widespread in suitable habitat in the Suisun Marsh, and in the Delta, salt marsh harvest mouse is restricted to salt and brackish tidal marshes along the northern edge of the Sacramento River and the southern edge of the San Joaquin River as far east as the vicinity of Collinsville and Antioch, west of Sherman Island.

Riparian Brush Rabbit

Riparian brush rabbit is federally listed and State listed as endangered. It occupies relatively large patches in riparian forests with a dense understory shrub layer. This species is closely tied to brushy cover and rarely moves more than a few feet from cover. It will not cross large, open areas, which limits its dispersal capabilities (USFWS 1998a), and this inability to disperse beyond the dense brush makes it susceptible to mortality during flood events (USFWS 1998a; Williams 1988). The primary threat to the survival of the riparian brush rabbit is the limited extent of its existing habitat, extremely low numbers of individual animals, and few extant populations. It is restricted to several populations at Caswell Memorial State Park, near Manteca in San Joaquin County; along the Stanislaus River; along Paradise Cut, a channel of the San Joaquin River in the southern part of the Delta; and a reintroduction on private lands adjacent to the San Joaquin River NWR (Williams 1993; Williams and Basey 1986).

San Joaquin Kit Fox

San Joaquin kit fox is federally listed as endangered and State listed as threatened. It occurs in open grasslands and scrub and will make dens where there are loose-textured soils. Threats include loss and fragmentation of habitat and the introduction of barriers to dispersal, such as highways and canals. The species is known to occur in grasslands in the southwest portion of the Delta, in eastern Contra Costa County. In May 2000, a small population was documented approximately 1.5 miles south of Clifton Court Forebay (CNDDB 2011).

Other Special-status Mammals

Eight other special-status mammals could occur in the Delta or the Suisun Marsh and be affected by implementation of the Delta Plan. These species and their habitat relationships are presented in Table 4-2. Four bat species that could have maternity or important migratory or winter roosts in the Delta are pallid bat, Townsend's big-eared bat, western mastiff bat, and western red bat. American badger is a species that typically occurs in grasslands or other upland habitats. Suisun shrew occurs in marshes of the Suisun Marsh. Big free-tailed bat could occur in the Suisun Marsh, although the last record of this species in the region is from 1916. Ringtail is not likely to occur in the Delta or Suisun Marsh because suitable habitat may not be present.

4.3.2.2.3 Invasive and Noxious Plant Species

Invasive and noxious plant species are those species considered detrimental to ecosystems or regional resources. "Invasive species" refers to "species that establish and spread rapidly outside of their native range, persist without human assistance, and have serious influence on their nonnative environment" (Simberloff et al.1997; Davis and Thompson 2000). The term "invasive plant" differs from the terms "nonnative," "exotic," "nonindigenous," or "introduced" plant because it is intended to describe those nonnative plant species that displace native species on a large enough scale to alter habitat functions and values, which may threaten the diversity or abundance of native species through competition for resources, predation, parasitism, hybridization with native populations, introduction of pathogens, or physical or chemical alteration of the invaded habitat.

Unlike the native plants they displace, many invasive plant species do not provide the food, shelter, or other habitat components on which many native fish and wildlife depend. Through their effects on natural ecosystems, agricultural and other developed lands, water delivery, and flood protection systems, invasive species may also negatively affect human health, the economy, or both (DFG 2008c).

"Noxious weed" is a term used by public land management agencies for nonnative plant species that have been designated as pests by law or regulation. "Nuisance plants" and "pest plants" are other terms used for both native and nonnative plant species that harm or interfere with commerce, agriculture, or other human-related activities, such as boating and water delivery. For the purposes of this analysis, only invasive and noxious plant species are discussed in this section.

A number of invasive plants that occur in the Delta and Suisun Marsh have been identified as important for additional research, monitoring, mapping, and control because of the substantial adverse effects they have had on the Bay-Delta system. These include submerged aquatic vegetation species, such as Brazilian waterweed, hydrilla, Eurasian milfoil, and parrot feather, and the floating, invasive water hyacinth. These weeds flourish in a wide geographic area, sometimes in high densities, and are harmful because of their ability to displace native plant species, harm fish and wildlife, reduce food web productivity, reduce turbidity, and interfere with water conveyance and flood control systems. Submerged aquatic vegetation has been implicated in the reduction in native juvenile and adult fish in areas with large amounts of submerged aquatic vegetation (IEP 2008; Grimaldo et al. 2004; Brown and Michniuk 2007).

Although several local and Delta-wide areas have been surveyed or assessed for specific invasive plants and noxious weeds—for example, in work by the California Department of Boating and Waterways (CDBW) to control Brazilian waterweed and water hyacinth (CDBW 2001, 2006)—no comprehensive survey of invasive plants and noxious weeds has been conducted for the Delta or Suisun Marsh. The California Aquatic Invasive Species Management Plan (CAISMP) provided the first comprehensive list of potential aquatic invasive species (DFG 2008c) for the Delta and Suisun Marsh.

Table 4-3 provides a list of invasive aquatic, wetland, and upland plants and noxious weeds known to occur or with potential to occur in and upstream of the Delta and Suisun Marsh and identifies their legal status, habitat, plant type, propagation mechanism, presence in the Delta or Suisun Marsh, and potential impact mechanisms. The table identifies species for which suitable habitat exists in the Delta and that are listed by the California Invasive Plant Council (Cal-IPC) Inventory (Cal-IPC 2010), are on the State noxious weed list (California Code of Regulations Title 3, Section 4500), or are on the U.S. Department of Agriculture noxious weed list (USDA 2006).

4.3.2.2.4 Importance of the Delta to Waterbirds

The Central Valley, including the Delta and Suisun Marsh, has a complex of wetland and agricultural habitats that is extremely important to migratory and wintering waterfowl, shorebirds, and other waterbirds (e.g., Heitmeyer et al. 1989; Shuford et al. 1998). The Delta also has valuable habitats for breeding waterbirds, including herons, egrets, and cormorants (Kelly et al. 2006; Shuford 2010). In addition to their needs for wetlands and agricultural fields as foraging habitats, species such as the sandhill crane may have high site fidelity and require secure nighttime roosts close to foraging areas (Ivey and Herziger 2003). The results of a study of herons and egrets in northern San Francisco Bay and the Suisun Marsh indicate that both the distribution of nesting colonies and reproductive performance may depend on landscape patterns within distances of at least 6 miles (Kelly et al. 2008). Colony site selection was associated primarily with the extent of particular wetland types within approximately a half-mile, suggesting the importance of local foraging opportunities. Overall, such findings indicate that various landscape features beyond the acreage of foraging habitats may be crucial to the conservation of waterbirds in the Delta. Recent regional conservation plans (Hickey et al. 2003; CVJV 2006) and landscape analyses (e.g., Stralberg et al. 2011) provide guidance for conservation and restoration of wetland and agricultural habitats in the Central Valley, including the Delta and Suisun Marsh. Ongoing evaluation of conservation goals is crucial because wetland habitat goals set for waterfowl in the Delta have not yet been met (CVJV 2006), and Delta-specific habitat goals have not been set for shorebirds and waterbirds (Hickey et al. 2003; CVJV 2006).

4.3.2.3 Natural and Agricultural Communities

The description of each biological community presented in the following discussion includes a description of how each biological community functions as habitat for common fish and wildlife. Semiaquatic wildlife and plant species and their habitats are also discussed, as appropriate. This section also explains how aquatic areas provide habitat for vascular plants, terrestrial and vernal pool invertebrates, amphibians, reptiles, birds, and terrestrial mammals. Habitats for special-status species are discussed in more detail in Appendixes F-3 and F-4.

The location and extent of natural and agricultural community types in the Delta and Suisun Marsh are presented in Figure 4-2. The acreage of each type is presented in Table 4-4.

Several of the natural community types in the Delta and Suisun Marsh are identified as special-status natural communities. These natural communities are of special concern to resource agencies or require focused analysis under the following legislative requirements or regulatory authority:

- CEQA
- Section 1602 of the California Fish and Game Code
- Section 404 of the Clean Water Act (CWA)
- Porter-Cologne Water Quality Control Act
- California Natural Community Conservation Planning Act

These requirements are further described in Appendix D, Regulatory Framework. Special-status natural communities are of special concern to resource agencies for a variety of reasons, including their locally or regionally declining status or because they provide important habitat to common and special-status species. Many of these habitats are monitored and reported in the CNDDB, which is maintained by DFG.

The natural communities listed below are described in the following text, including how each is used by common fish and wildlife species. The following natural communities are present in the Delta and Suisun Marsh:

- Tidal wetlands
  - Tidal open water
  - Tidal mudflat
  - Tidal brackish marsh
  - Tidal freshwater marsh
- Nontidal wetlands
  - Nontidal open water
  - Nontidal brackish marsh, managed
  - Nontidal freshwater marsh, unmanaged
  - Nontidal freshwater marsh, managed
- Alkali seasonal wetland
- Vernal pool
- Riparian
  - Riparian forest
  - Riparian scrub
  - Riparian invasives
- Inland dune scrub

Each of these communities, except inland dune scrub, includes wetlands that may be under federal (CWA) or State (Porter-Cologne Water Quality Control Act) jurisdiction.

4.3.2.3.1 Tidal Wetlands

Tidal marshes in the Delta and Suisun Marsh consist of several distinct landform elements.

- Vegetated marsh plains
- Channel slough networks that are sinuous (having many turns) and dendritic (branching multiple times) with depths that can be subtidal or intertidal
- Higher elevation channel banks where the highest tides deposit their sediment loads
- Ponds on the marsh plain that may hold water temporarily and permanently
- Ponds along the marsh-upland edge that capture local runoff and extreme high tides
- Mudflats along the banks of channels and at the water-side marsh edge except in low-energy freshwater environments where vegetation colonizes these areas

Delta tidal marshes are predominantly freshwater, whereas Suisun Marsh tidal marshes are predominantly brackish. The confluence of the Delta and Suisun Marsh is subject to the greatest salinity variability; thus, the tidal marshes in these areas can fluctuate between brackish and freshwater conditions.

Historically, much of the Delta and Suisun Marsh was tidal marshlands, containing roughly 380,000 and 60,000 acres of tidal marsh, respectively. Today, the Delta supports approximately 7,000 acres, composed almost entirely of restored wetlands with some small patches of historic marsh (mostly small in-channel islands) remaining (see Figure 4-2). The largest patches of restored marsh are found at Sherman Island, Big Break, Liberty Island, and Little Holland Tract. Suisun Marsh has approximately 8,000 acres of tidal marsh, composed of a mix of ancient or historic marsh, centennial marsh (marsh formed on 19th-century Sierra Nevada hydraulic mining debris), and fringing marsh formed along banks of sloughs where tidal marsh has been diked and thus tidal flows reduced.

4.3.2.3.2 Tidal Open Water

The tidal open water community is defined as (a) deep open water (greater than 10 feet deep from mean lower low tide [i.e., 19-year average of the lowest of the two low tides during the daily tidal cycle]), and (b) shallow open water (less than or equal to 10 feet deep from mean lower low tide) zones of estuarine bays, river channels, and sloughs. Under present operations, tidal open water in the Delta is mainly freshwater habitat, with brackish conditions occurring in the western Delta at times of high tides and low flows into the western Delta. In Suisun Marsh, surface waters are mainly brackish and occasionally fresh during times of high Delta outflow and saline during times of low Delta outflow.

Native fish that are found in tidal portions of the aquatic community include delta smelt, Sacramento splittail, Chinook salmon, steelhead, and sturgeon. Tidal areas are also used by a variety of nonnative fishes such as inland silverside, sunfish, bass, and shad (Moyle 2002, p. 9 Table 3).Aquatic vegetation in the Delta and Suisun Marsh can be separated into two general categories: floating aquatic vegetation and submerged aquatic vegetation (Cowardin et al. 1979). The geographic extent of this vegetation changes frequently because it depends on highly variable physical factors, such as depth, turbidity, water flow, salinity, substrate, and nutrient availability. Presence of floating or submerged aquatic vegetation can influence foraging habitat suitability in shallow water, benefiting some species and harming others.

Floating Aquatic Vegetation

Floating aquatic vegetation extends over the open water surface, either as free-floating plants or as colonies extending from plants rooted in banks. Some floating aquatic vegetation is native (e.g., most water primrose species and subspecies), but most floating aquatic vegetation in the Delta consists of highly invasive nonnative plants, such as water hyacinth, that occur in dense floating mats so thick they choke canals, channels, and irrigation ditches.

Floating aquatic vegetation also occurs in sloughs, especially near their source of origin where flows are slow. Abundant floating aquatic vegetation frequently presents a nuisance to boaters. Even native floating aquatic plants may become overabundant and invasive in nutrient-rich waters of urban and agricultural watersheds with diminished tidal and freshwater outflows. Floating aquatic vegetation borders marshes along large sloughs and small tidal channels in the Delta and may accumulate in such large quantities that it may affect marsh vegetation by smothering it with decomposing masses of debris. Floating aquatic vegetation has not been detected in the Suisun Marsh, presumably because of the salinity intolerance of the native and exotic species.

Submerged Aquatic Vegetation

Submerged aquatic plants have leaves and stems that are fully submerged for all or nearly all of their life cycle, and they often have root systems reduced to minimal anchorage structures in pond or riverbeds. Many native submerged aquatic species, including pondweeds (e.g., sago pondweed) and stoneworts (green algae structurally similar to vascular plants), are highly valuable food plants for waterfowl and nursery habitat for aquatic invertebrates and fish. Submerged aquatic vegetation may form patches or beds of extensive bottom “canopy” habitat. In the Delta, nonnative invasive submerged aquatic species dominate and replace native species and naturally bare open water slough beds. Brazilian waterweed, also known as egeria, is invasive, extremely competitive with native species, effective at filtering out suspended sediment, and capable of surviving at great water depths. It has structural characteristics that create suitable cover and shelter for predatory nonnative fish (such as bass) in tidal slough beds. Submerged aquatic vegetation in the Delta may be viewed unfavorably in aquatic restoration and management because of Brazilian waterweed, which is rapidly established in shallow or deep subtidal habitats, including at some restoration sites.

Wildlife species associated with aquatic habitats vary with water depth and other habitat features. Deeper open water areas without vegetation provide foraging habitat for wildlife such as terns; gulls; osprey; cormorants; diving ducks, such as scaup and canvasback; and river otters, which feed primarily on fish, crayfish, and other aquatic organisms. Shallower water provides foraging habitat for reptiles such as western pond turtle; dabbling ducks, such as American wigeon and northern pintail, which feed on a variety of plant material and invertebrates; and large wading birds, such as egrets and herons.

4.3.2.3.3 Tidal Mudflat

The tidal mudflat community typically occurs as mostly unvegetated sediments in the intertidal zone between the mean high water and the mean lower low water. This natural community is exposed above water at low tide and is typically associated with tidal freshwater marsh or tidal brackish marsh at its lower edge. Tidal mudflats are uncommon in the Delta because emergent marsh plants are able to grow to below low-tide levels; thus, mudflat occurs only where flows are too rapid to allow plant colonization. Mudflats are also uncommon in the Suisun Marsh even though the plant species tolerant of brackish water do not often grow to low-tide level; physical factors, such as rates of sediment erosion and deposition, may limit intertidal mudflat in the Suisun Marsh.

A great abundance and diversity of invertebrates are found at varying depths in the substrate, and they support a variety of foraging shorebirds, such as western sandpiper, least sandpiper, dunlin, long- and short-billed dowitchers, whimbrel, and long-billed curlew; wading birds, such as great blue heron, great egret, and black-crowned night-heron; and dabbling ducks, such as cinnamon and green-winged teal and mallard. As the tide rises and mudflats are inundated with deeper water, wildlife species composition shifts to those described above for submerged aquatic vegetation.

4.3.2.3.4 Tidal Brackish Marsh

Tidal brackish marsh occurs in the San Francisco Bay saltwater/Delta freshwater mixing zone that extends from near Collinsville westward to the Carquinez Straight, as well as upstream along major tributaries to San Francisco Bay, such as Napa River and Petaluma River in the North Bay and Coyote Creek in the South Bay. Tidal brackish marsh is present on the south side of Suisun Bay and on islands in the channel, but is most extensive in the Suisun Marsh.

The tidal brackish marsh community is found in undiked areas of the Suisun Marsh. Ancient marshes are Rush Ranch, Peytonia Slough, and Hill Slough, which include upland transitions and Browns Island; centennial marshes include the tip of Joice Island; and fringing marshes are found along the margins of many of the tidal sloughs in the Suisun Marsh. Tidal brackish marsh plant communities reflect the tidal inundation regimes (mainly elevation but also proximity to tidal channels and sloughs) and water salinity. Tide ranges are a little below 5 to 6 feet in the Suisun Marsh (DWR 2004a). The tidal brackish marshes of the Suisun Marsh are the most floristically diverse marshes in the estuary (roughly 70 species at Rush Ranch [Siegel 1993]) because they support a broad mixture of freshwater plant species growing in their most salt-tolerant conditions alongside salt-tolerant species growing in a more freshwater setting. The salt stress of the tidal brackish marshes prevents tules and cattails from growing as low in the tidal range as is found in the Delta. Eight plant community alliances mapped in the Delta and Suisun Marsh fall within the tidal brackish marsh community (Hickson and Keeler-Wolf 2007; Keeler-Wolf and Vaghti 2000).

Tidal brackish marsh in the Suisun Marsh area is habitat for several special-status plant species: soft bird’s beak, Contra Costa goldfields, and Suisun thistle, Suisun Marsh aster, Delta tule pea, Mason’s lilaeopsis, Carquinez goldenbush, San Joaquin spearscale, heartscale, brittlescale, alkali milk vetch, Delta mudwort, Lyngbye’s sedge, and Bolander’s water-hemlock.

On the marsh plain, typical wildlife present include salt marsh harvest mouse; ornate shrew; northern harrier; California clapper rail in the westernmost marshes of the Suisun Marsh; California black rail; Suisun song sparrow; common yellowthroat; marsh wren; red-winged blackbird; tricolored blackbird; and large wading birds, such as egrets and herons (Kelly et al. 2008).

4.3.2.3.5 Tidal Freshwater Marsh

Tidal marshes occupy the intertidal and, in freshwater, shallow subtidal elevation ranges. Tide ranges in the Delta are approximately 3 to 4 feet, diminishing to zero at the riverine boundaries of the Delta (DWR 2004a).

In the Delta, tidal freshwater marsh has been nearly eliminated, and no large patches of historic marsh remain. The bulk of the modern tidal marshes are the result of natural levee failures (Sherman Island [1920s], Big Break [1930s], Little Holland Tract [1983 and 1992], and Liberty Island [1998]). The distribution of tidal freshwater marsh in the Delta is shown in Figure 4-2.

Tidal freshwater marsh vegetation naturally occurs along a hydrologic gradient in the transition zone between open water and riparian vegetation or upland terrestrial vegetation, such as grasslands or woodlands. In the Delta, these natural transitions have been converted to abrupt transitions to agricultural cover, managed wetlands, and boundaries formed by levees and other artificial landforms. Seventeen plant community alliances are mapped in the Delta in the tidal freshwater marsh natural community (Hickson and Keeler-Wolf 2007).

Tidal freshwater marsh is regularly flooded tidal marshlands with very low levels of soil salinity. These communities can be categorized based on their frequency of inundation, which is driven by elevation and drainage ability. The low-elevation tidal freshwater marsh is influenced by the daily tides and is frequently flooded. Middle-elevation tidal freshwater marsh is regularly flooded, but the soil is exposed above the water level for many hours each day. High-elevation tidal freshwater marsh is occasionally flooded by tides. Depressions on the marsh landscape remain flooded after tides recede. All marshes are inundated when the Delta is affected by watershed high flow and flood events.

Low-elevation tidal freshwater marsh typically is dominated by tules and occasionally includes species of cattails. They are highly productive but support few species other than tules, which tolerate deep, prolonged tidal flooding. The middle-elevation tidal freshwater marsh is more diverse in plant species (e.g., bur-reed, broadleaf arrowhead, and water smartweed), even though this community may also be dominated by tules.

Invasive nonnative plants, such as yellow flag and purple loosestrife, tend to invade this species-rich freshwater zone. The middle-elevation tidal freshwater marsh zone grades into the uppermost end of tidal freshwater marsh (high-elevation intertidal marsh zone).

The high-elevation tidal freshwater marsh zone can be dominated by grass and grasslike species, such as Baltic rush, creeping wildrye, and saltgrass. It typically includes large patches of yerba mansa and wild heliotrope. Special-status plant species commonly found in this plant community include Suisun Marsh aster and rose-mallow. Large thickets of nonnative Himalayan blackberry invade high-elevation tidal freshwater marsh, converting the marsh to riparian scrub thickets. The marsh-upland transition in the Delta and Suisun Marsh tends to support different vegetation, with the Delta supporting more riparian scrub and tree species and grasses and the Suisun Marsh supporting mainly a variety of grasses though riparian scrub and trees are found near local tributaries. High marsh-upland transition edges are uncommon because these landscape features have been converted to other land uses.

Fish species that use tidal open water habitats also occur in the accessible portions of tidal marsh. Wildlife species composition in sparsely vegetated areas in low-elevation tidal freshwater marsh is similar to the composition described previously for tidal mudflat. Other wildlife that use these productive wetlands as foraging habitat and the dense vegetation as cover, especially in the low- and middle-elevations, include western pond turtle, wading birds (egrets and herons), waterfowl (ducks, geese), rails, shorebirds (e.g., plovers, sandpipers), and perching birds. Common nesting birds include red-winged blackbird, marsh wren, common yellowthroat, and black-crowned night-heron. American beavers and muskrats forage on marsh plants and use them for cover and den material. In the high-elevation zone, typical grassland species can be found, in addition to species such as short-eared owl, which nests in tall weedy fields and moist meadows. Tidal marshes are prodigious producers of insects, and serve as foraging areas for many bird species, including special-status species such as Swainson's hawk (DFG 2006b; Bradbury 2009).

The banks of tidal channels often provide unique habitats because of their steep gradients of inundation, exposure to a wide range of flows and disturbance regimes, and substrates distinct from the marsh plain. Tidal marsh channel banks are important habitat for two special-status plant species: Mason's lilaeopsis and Delta mudwort (Fiedler and Zebell 1993; Witham and Kareofelas 1994). Other species found along tidal marsh channel banks include Suisun marsh aster and Lyngbye's sedge.

4.3.2.3.6 Nontidal Wetlands

Nontidal Open Water

Nontidal open water in the Delta and Suisun Marsh can range in size from small ponds in uplands to large lakes, such as North and South Stone Lakes. The nontidal open water community can be found in association with any terrestrial habitat and can transition into nontidal freshwater marsh and riparian scrub or forest. This natural community is differentiated from the tidal open water community described above by a physical separation from the tidally influenced sloughs and channels in the Delta.

Dominant plant species present in the nontidal open water community include most of the species mentioned for the tidal open water community, including floating water primrose, water hyacinth, and Brazilian waterweed. Vegetation in nontidal open water can be similarly characterized as floating aquatic vegetation and submerged aquatic vegetation (see description above).

Nontidal open water communities provide foraging habitat for wildlife that mainly depends on other habitats for breeding and cover. Typical species include pied-billed grebe, western grebe, double-crested cormorant, mallard, ruddy duck, canvasback, bufflehead, and river otter. Native fish that are (or were) found in some nontidal areas (primarily ponds and lakes) include the Sacramento perch, hitch, and tule perch (Moyle 2002, p. 9 Table 3). Nontidal areas support many nonnative freshwater fishes, including sunfish, common carp, inland silverside, fathead minnow, and western mosquitofish.

Nontidal Brackish Marsh, Managed

In the Suisun Marsh, land management practices largely dictate natural community types. The classification as either tidal brackish marsh, as described previously, or as managed wetland is determined by the presence of a levee or dike and the side of the structure on which the vegetation is located. San Francisco Estuary Institute's EcoAtlas GIS dataset was used as a general guide to determine whether vegetation units in the Suisun Marsh would be classified as managed wetland or tidal brackish marsh. Salinity is a significant management issue in the Suisun Marsh; therefore, water use is regulated (Suisun Ecological Workgroup 1997). Managed brackish marsh vegetation is often dominated by pickleweed and brass buttons.

Nontidal Freshwater Marsh, Unmanaged

The unmanaged nontidal freshwater marsh community is composed of permanently saturated wetlands, including meadows, dominated by emergent plant species that do not tolerate permanent saline or brackish conditions (CALFED 2000b). Nontidal freshwater marsh communities in the Delta occur in small fragments along the edges of the nontidal open water and riparian natural communities (Figure 4-2). These marshes typically occur on the land side of the Delta levees. Shallow (water less than 3 feet deep) marshes are dominated by thick, tall, highly productive stands of tules and cattails.

Other locally abundant grasslike freshwater marsh species include common spikerush, rabbit's-foot grass, and dallisgrass. Various other forbs can occur in nontidal freshwater marshes; however, tules or cattails usually dominate the vegetation. Characteristic forbs in nontidal freshwater marshes include cocklebur, curly dock, and several knotweed species. The higher elevation edges of freshwater marsh gradients may be characterized by abrupt transitions to upland vegetation, or they transition into vegetation of alkali seasonal wetlands, riparian woodland, or riparian scrub.

Nontidal freshwater marshes are important foraging or breeding habitat for a variety of wildlife species; dense emergent vegetation provides concealment from predators. Reptiles and amphibians associated with marsh habitats include common garter snake, Pacific chorus frog, bullfrog, and western pond turtle. Locally common to abundant wading birds (egrets and herons), waterfowl (ducks, geese, and swans), rails, shorebirds (e.g., plovers, sandpipers), and perching birds (e.g., red-winged blackbird, marsh wren, common yellowthroat, song sparrow) use nontidal marsh habitat for foraging, cover, or nesting. American beavers and muskrats forage on marsh plants and use them for cover and den material. Bird species use may vary considerably either locally or seasonally with vegetation height and density, proportion of vegetation to open water, and the amount of shallow water and mudflat.

Nontidal Freshwater Marsh, Managed

Managed nontidal freshwater marsh consists of areas that are intentionally flooded and managed during specific seasonal periods to enhance habitat values for specific wildlife groups (e.g., waterfowl, shorebirds) (CALFED 2000b). Associated ditches and drains used to manage the water level are included in this community. Managed nontidal freshwater marsh is distributed throughout the Delta, with a substantial acreage of managed nontidal marsh occurring in the Yolo Bypass, Stone Lakes NWR, and Cosumnes River Preserve (DFG 2008c; USFWS 2007d). Several islands in the central Delta also support large areas of this community type, including Mandeville Island, Medford Island, Holland Tract, and Bradford Island. The far western edge of the Delta, including Van Sickle and Chipps islands, also include managed freshwater marsh. Water at the far western border of the Delta and in the Suisun Marsh can be more brackish compared to other portions of the Delta where this community occurs (Suisun Ecological Workgroup 1997).

The typical hydrologic management regime includes flooding during the fall arrival of migratory birds, followed by a slow to rapid drawdown in late winter or spring to limit vegetation growth, manage seed production, and control mosquito populations, depending on management goals. Summer irrigation may also be conducted (USFWS 2007d).

The managed freshwater marsh community is characterized by robust, perennial emergent vegetation and annual-dominated moist-soil grasses and forbs in freshwater areas (Hickson and Keeler-Wolf 2007). Vegetation that is important to waterfowl includes alkali bulrush, grand redstem, brass buttons, knotweed, barnyard grass, burhead, and swamp timothy (Suisun Ecological Workgroup 1997; USFWS 2007d). During periods when water is drained from the habitat, a wide variety of annual grasses and forbs germinate and grow beneath and in the space around clumping emergent plants, such as cattails and tules.

Managed wetlands are often managed specifically as habitat for wintering waterfowl species, including northern pintail, mallard, American wigeon, green-winged teal, northern shoveler, gadwall, cinnamon teal, ruddy duck, canvasback, white-fronted goose, and Canada goose. Some wetlands are also managed for breeding waterfowl, especially mallards. They also may be managed specifically for various shorebird species (e.g., at the Yolo Bypass WA) that also rely on wetlands in the Delta and Suisun Marsh for habitat during winter, spring, and fall migration, and, to a limited extent, for breeding. Species regularly observed during these periods include American avocet, black-necked stilt, killdeer, western and least sandpipers, long-billed dowitcher, dunlin, greater and lesser yellowlegs, whimbrel, long-billed curlew, and Wilson's phalarope. Other wildlife species that use managed wetlands include those described for tidal brackish marsh (especially for managed wetlands in the Suisun Marsh), nontidal freshwater marsh, and tidal freshwater marsh.

Alkali Seasonal Wetland

Alkali seasonal wetland occurs on alkaline soils with ponded or saturated soil conditions for prolonged periods during the growing season. The vegetation of alkali seasonal wetland is composed of salt-tolerant plant species adapted to wetland conditions and high salinity levels. This natural community consists of seasonally ponded and saturated wetlands in a surrounding matrix of grassland. It is typically found either

at the historical locations of lakes or ponds in the Yolo Basin in and around the DFG Tule Ranch Preserve (Witham 2003) where salts accumulated through evaporation or in upland situations, such as basin rims and seasonal drainages that receive salts in runoff from distant upslope salt-bearing rock, such as areas near the Suisun Marsh and the Clifton Court Forebay (Figure 4-2).

The composition of alkali seasonal wetlands can vary from site to site, and these wetlands may include species typically associated with communities designated by Holland (1986) as alkali grassland, alkali sink, chenopod scrub, brackish marsh, valley sink scrub, and alkali vernal pools. Alkali seasonal wetlands can be rich in plant species, and they often provide suitable habitat for a number of special-status plant species. Dominant grasses in alkali seasonal wetlands and surrounding grassland include saltgrass and wild barley. The associated herb cover consists of salt-tolerant species, including saltbush, alkali heath, alkali weed, alkali mallow, and common spikeweed. The Delta supports small stands of alkali sink scrub (also known as valley sink scrub), which are characterized by iodine bush. Alkali seasonal wetlands are rare in the Delta, occurring primarily around the Clifton Court Forebay, in southeastern Solano County, and in the Yolo Bypass.

Vernal Pool

Vernal pools are seasonal wetlands that form in shallow depressions underlain by hardpan or a dense clay subsurface layer. These depressions fill with rainwater and surface runoff, and because the subsurface layers restrict infiltration into the subsoil, the depressions remain inundated throughout winter and sometimes as late as early summer. Vernal pools are found in areas of level or gently undulating topography in the lowlands of California, especially in the grasslands of the Central Valley. Although these wetlands are typically small, some vernal pools can reach several acres in size. Rising spring temperatures cause the water in vernal pools to evaporate, promoting the growth of concentric bands of various plant species, especially native wildflowers, along the shrinking edge of the pool. Vernal pool vegetation in California is characterized by a high percentage of native species, several of which have restricted ranges. Many plant species, and a number of animal species associated with vernal pools, are federally listed or State listed as rare, threatened, or endangered.

The vernal pool community is rare in the Delta and Suisun Marsh and is generally found only in a few locations along the margin of the area (Figure 4-2). Vernal pools typically occur in interconnected and isolated groups of vernal pool wetlands and seasonal swales in a matrix of grassland. In the Delta and Suisun Marsh, vernal pools occur in the vicinity of the Stone Lakes NWR, the Yolo Bypass, southeastern Solano County, and the Clifton Court Forebay. Vernal pool habitat in California's Central Valley has been in decline over the last decades (Holland 2009b). In the Delta and Suisun Marsh, degraded vernal pools may be found in areas where vernal pool terrain micro-topography has been leveled. These degraded vernal pools still support special-status species but typically are inundated for shorter periods than undisturbed vernal pools. Degraded vernal pools can be found in the Stone Lakes NWR and in the vicinity of the Clifton Court Forebay.

During winter and spring, when vernal pools or seasonal wetlands are filled with water, plants, and aquatic life, they act as an important foraging and occasionally breeding habitat for a variety of common and special-status species, including dabbling ducks, herons and egrets, and shorebirds (Silveira 1998); invertebrates, such as various native bee species and vernal pool fairy shrimp; and reptiles and amphibians, such as the common garter snake and Pacific chorus frog. During dry summer months, they also provide protection for eggs, cysts, or seeds of many of the aquatic breeding species.

4.3.2.3.7 Riparian Communities

Riparian Forest

The riparian forest community often functions as a transition zone between aquatic and upland terrestrial habitat and is found in a wide range of geologic, soil, and other environmental conditions (e.g., variable light and nutrient availability) throughout the Delta (The Bay Institute 1998; Vaghti and Greco 2007). The current extent of the riparian forest community represents a small proportion of its historical extent in the Delta. Historically, riparian vegetation was distributed along all major and minor waterways and floodplains throughout the Delta (The Bay Institute 1998).

The overall area of the formerly contiguous riparian forests has been reduced, and the remaining habitat exists in isolated fragments. Riparian forest communities occur in the Delta most often as long, linear patches bordering agricultural or urban land or in low-lying, flood-prone patches near river bends, canals, or breached levees (Figure 4-2). Less frequently, they also border other terrestrial biological communities. The remaining riparian forest patches are located along many of the major and minor waterways, oxbows, and levees in the Delta, including the Sacramento River, the Sacramento Deep Water Ship Channel, the Yolo Bypass, and channels of the San Joaquin River and the Delta. Isolated patches of riparian vegetation are also found on the interior of reclaimed Delta islands; along drainage channels; along pond margins; and in abandoned, low-lying fields.

The Delta supports winter-deciduous riparian forest and woodlands with canopy covers ranging from relatively open to very dense. At present, riparian forest and woodland communities dominated by tree species are mostly limited to narrow bands along sloughs, channels, rivers, and other freshwater features throughout the Delta. Cottonwoods and willows, mixed with bigleaf maple, Oregon ash, box elder, and California sycamore, are the most common riparian trees in central California. Valley oak is common in riparian areas in the Central Valley, as is walnut. Equivalent communities, as described by Holland (1986), include Great Valley cottonwood riparian forest, Great Valley mixed riparian forest, Great Valley valley oak riparian forest, and white alder riparian forest.

Riparian forest is considered a sensitive natural community and is subject to DFG regulations under section 1600 et seq. of the California Fish and Game Code. Riparian forest and woodlands are also considered sensitive communities because they have sustained considerable losses throughout the state and because they provide habitat and shelter for large numbers of common and special-status species.

Riparian habitat supports a wide variety of wildlife species (Golet et al. 2008). In particular, riparian areas are critical for birds, including neotropical migrant perching birds (Rich 2002). Birds use riparian forests (including canopy, subcanopy, understory, and snags) for nesting, foraging, and protective cover. Riparian forest habitat also offers vital overwintering and migration stopover areas and corridors for dispersal (Gaines 1977; Humple and Geupel 2002).

Birds using riparian forests include Swainson's hawk, Cooper's hawk, black-headed grosbeak, blue grosbeak, tree swallow, and yellow warbler. Riparian canopies provide nesting and foraging habitat for common mammals, such as western gray squirrel, and roosting habitat for some bat species, such as western red bat, hoary bat, and California myotis. Riparian forest often has a shrubby understory composed of species similar to those discussed below for riparian scrub. A well-developed understory is beneficial for nesting birds (RHJV 2004). Understory shrubs provide cover for mammals, such as desert cottontail, and for ground-nesting and shrub-nesting birds, such as the song sparrow and spotted towhee, that forage among the vegetation and leaf litter. Mammals such as raccoon and opossum feed on the variety of berries, invertebrates, small mammals, and bird eggs.

Riparian Scrub

Like the riparian forest community, the riparian scrub community often functions as a transition zone between aquatic and upland terrestrial habitat and is found in a wide range of geologic, soil, and other environmental conditions (The Bay Institute 1998; Vaghti and Greco 2007). Riparian scrub in the Delta and Suisun Marsh consists of woody riparian shrubs in dense thickets. Plant species may include willows, blackberries, buttonbush, mulefat, and other shrub species. These thickets are usually associated with higher, sloping, better drained edges of marshes or topographic high areas, such as levee remnants and elevated flood deposits. They may occur along shorelines of ponds or banks of channels in tidal or nontidal freshwater habitats. Willow thickets provide important habitat for a wide range of wildlife species, including the song sparrow, lazuli bunting, elderberry longhorn beetle, and least Bell's vireo. (Although the latter species is mostly extirpated from Northern California [Howell et al. 2010], a nonbreeding male was detected at Yolo Bypass in 2010.) During extreme floods, dense and tall riparian willow thicket canopies may remain partially above water levels, trap debris and sediment, and act as permeable barriers to wave energy traveling across open water. Nonnative Himalayan blackberry thickets are a common element of riparian scrub communities along levees and throughout pastures in the levees.

Riparian Invasives

A number of invasive nonnative plant species are particularly problematic in riparian environments where they displace native species and form monotypic stands of vegetation. After they become established, these stands can be extremely difficult to control or eradicate. The Delta and Suisun Marsh support 92 acres of nonnative trees found in the riparian context. Areas of nonnative riparian tree stands are mapped as black locust or tree of heaven (Hickson and Keeler-Wolf 2007). These areas do not meet the criteria of special-status plant communities as defined above.

Nonnative invasive species in riparian natural communities include giant reed, tree of heaven, red sesbania, black locust, Chinese tallow, and tamarisk. The introduction of giant reed, for instance, has negatively affected the native riparian forest and scrub communities because the species grows in dense monocultures, displacing natives and changing hydrological regimes. By eliminating native plants, giant reed removes food and habitat for a number of insects, birds, and other wildlife.

4.3.2.3.8 Grassland

The grassland community includes a spectrum of vegetation types, ranging from natural to intensively managed vegetation dominated by grasses. At the more natural end of the spectrum, it is composed of introduced or native annual and perennial grasses and forbs (nongrass herbaceous species) (Hickson and Keeler-Wolf 2007). At the intensively managed end of the spectrum, it includes irrigated and nonirrigated pasturelands (CALFED 2000b). Grasslands are often found adjacent to wetland and riparian habitats and are the dominant community on managed levees in the Delta (Hickson and Keeler-Wolf 2007). The distribution of the grassland community in the Delta and Suisun Marsh is shown in Figure 4-2.

Grassland communities are generally dominated by nonnative species, such as wild oats, various bromes and barleys, Italian rye-grass, filarees, mustards, wild radish, mallows, vetches, and star-thistles. They may also support infrequent native annual and perennial grasses and forbs. In some areas of the Delta and Suisun Marsh, the grassland community is interspersed with vernal pools and alkali seasonal wetlands. *A Manual of California Vegetation* (Sawyer et al. 2009) recognizes the broad spectrum of grassland types and includes vegetation types ranging from those that are completely dominated by nonnative annual grasses to grasslands that are dominated by perennial native grasses. Plant species that can sometimes be found in the grassland community that contains patches of other vegetation types include alkali milk-vetch, Heckard's peppergrass, San Joaquin spearscale, and other special-status plant species.

The grassland community designation has been applied to areas that have been cleared of their natural vegetation cover, such as levee faces and edges of agricultural fields and roads. Vegetation in these areas is best characterized as ruderal. Ruderal vegetation is dominated by herbaceous, nonnative, weedy species and may also support stands of noxious weeds. Although grasslands may occasionally support special-status species, ruderal vegetation usually does not. Ruderal vegetation in the Delta and Suisun Marsh has variable compositions, including noxious invasive weeds, such as common mallow, bull thistle, bindweed, poison hemlock, wild lettuce, tumbleweed, and many nonnative annual grasses, including wild oats, bromes, and barleys. Ruderal vegetation on maintained levees throughout the Delta can be a persistent source of seeds of weedy and invasive plants. Some native annuals, such as common spikeweed and willowherb, are also common.

Grassland communities provide foraging, breeding, and cover habitat value for a variety of common wildlife species, including gopher snake, western racer, western meadowlark, northern harrier, red-tailed hawk, western harvest mouse, and California vole. Grasslands provide important habitat for special-status species, such as the greater and lesser sandhill cranes (Littlefield and Ivey 2000; Ivey and Herziger 2003), mountain plover, long-billed curlew (Shuford et al. 2009), loggerhead shrike, and tricolored blackbird. Because nonnative annual grasslands are dominated by exotic plant species, they may provide fewer habitat values than native grasslands.

Wildlife communities in fallow and ruderal fields are often similar to those in cultivated row crop or silage fields. The absence of active cultivation increases the potential for successful bird nesting; however, these habitats provide limited breeding habitat for grassland-associated wildlife, such as western meadowlark, American goldfinch, northern harrier, and California vole.

4.3.2.3.9 Inland Dune Scrub

The inland dune scrub community is composed of vegetated, stabilized sand dunes associated with river and estuarine systems. In the Delta, the inland dune scrub community includes remnants of low-lying ancient stabilized dunes related to the Antioch Dunes formation located near the town of Antioch. The historic vegetation of these largely stabilized ancient interior dunes included perennial grassland, oak woodland, and local “blowout” areas (naturally disturbed, unstable, wind-eroded and depositional sites, or river-cut sand cliffs, in stabilized dunes) that supported the distinctive dune species that survive at the Antioch Dunes NWR (USFWS 2001).

The remaining dune remnants in the Delta are highly fragmented and in many cases are dominated by nonnative weedy vegetation and trees, as opposed to the characteristic native vegetation of interior dune remnants at the Antioch Dunes NWR. Stabilized sand dunes are found on Brannan Island, south of Dutch Slough, and in other small areas throughout the Delta and Suisun Marsh. Plant communities found on dune soils typically are dominated by ripgut brome, yellow star-thistle, telegraph weed, wild lettuce, wild radish, beach suncup, and yarrow, with occasional shrubs such as deerweed, nude buckwheat, Chamisso’s lupine, and silvery bush lupine.

Inland dune scrub is considered a special-status biological community because it provides suitable habitat for Antioch Dunes evening primrose and Contra Costa wallflower, which are federally listed and State listed as endangered. Because of their limited distribution, the presence of sensitive species, and their declining geographic extent, dunes are also tracked by DFG.

Rare invertebrates have been collected at the isolated dune habitat at the Antioch Dunes NWR since the 1930s. One of the more notable species found here is Lange’s metalmark butterfly, federally listed as endangered, which is restricted to the Antioch Dunes. Other wildlife species associated with this habitat include common mammals, such as Botta’s pocket gopher, California ground squirrel, Townsend’s mole, and black-tailed jackrabbit; reptiles such as silvery legless lizard, western racer, side-blotched lizard, and western fence lizard; and various resident and migratory bird species.

4.3.2.3.10 Agricultural Lands

Agricultural communities are cultivated lands that are farmed in the Delta and Suisun Marsh. Major crops and cover types in agricultural production include small grains (wheat and barley), field crops (corn, sorghum, and safflower), truck crops (tomatoes and sugar beets), forage crops (hay and alfalfa), pastures, orchards, and vineyards. The distribution of seasonal crops varies annually, depending on crop-rotation patterns and market forces. In many areas, cropping practices result in monotypic stands of vegetation for the growing season and bare ground in fall and winter. Some farmland is more intensively managed to provide wildlife habitat in addition to crops. Regular maintenance of fallow fields, roads, ditches, and levee slopes can reduce the establishment of ruderal vegetation or native plant communities.

Alfalfa

Alfalfa is an irrigated, intensively mowed, leguminous crop that constitutes a dynamic habitat. Vegetation structure varies with the growing, harvesting, and fallowing cycles. Alfalfa is rotated periodically with other crops, such as vegetables and cereal grains. It is a productive crop that does not require frequent tilling, so it can support large populations of small mammals (e.g., voles) and invertebrate species. As a result, it provides high-quality foraging habitat for wildlife, including wading birds, shorebirds, sparrows, blackbirds, and hawks. Many of these species, such as shorebirds, use the fields when they are periodically flood irrigated, making invertebrate prey more available. Alfalfa can be particularly important to Swainson's hawk, white-tailed kite, and other raptor species, which capitalize on high prey densities and cycles of increased prey availability when the fields are being irrigated and mowed. In fall, alfalfa and irrigated pasture are the most important crops to the long-billed curlew, a shorebird of conservation concern (Shuford et al. 2009). Alfalfa is an important crop in the Delta for foraging sandhill cranes (Littlefield and Ivey 2000; Ivey and Herziger 2003).

Irrigated Pasture

Pastures are managed grasslands that are not typically tilled or disturbed frequently. They are usually managed with a low structure of native herbaceous plants, cultivated species, or a mixture of both. Pastures provide breeding opportunities for some ground-nesting birds and burrowing animals, such as burrowing owl, western meadowlark, California ground squirrel, and Botta's pocket gopher. The open structure of pastures provides foraging habitat for grassland-foraging wildlife, such as red-tailed hawk, Swainson's hawk, western meadowlark, savannah sparrow, blackbirds, and coyote. Irrigated pastures are important foraging habitats for greater and lesser sandhill cranes (Littlefield and Ivey 2000; Ivey and Herziger 2003) and Aleutian cackling geese (Zeiner et al. 1990) during fall and winter. Irrigated pasture is one of two key habitats for long-billed curlews in the Central Valley in fall (Shuford et al. 2009), and when flood irrigated, such pastures are also valuable forging habitat for a variety of shorebirds and waders.

Corn

Corn is the most abundant grain crop in the Delta, and flooded corn acreage in winter greatly exceeds that of managed freshwater wetlands in the Delta exclusive of the Suisun Marsh (CVJV 2006, pp. 28 and 35). Although it is grown throughout the Delta, corn occurs in the highest density in the central Delta. Many species of waterbirds make extensive use of cornfields, particularly fields that are chopped and rolled after harvest. Waste corn is the primary carbohydrate food resource for cranes in the Delta (Littlefield and Ivey 2000; Ivey and Herziger 2003). Besides foraging in corn, cranes use flooded fields for loafing and nighttime roosts. Geese, particularly Aleutian cackling geese, can be abundant on both wet and dry chopped and rolled fields. Depending on water depth, flooded corn is also used extensively by shorebirds, egrets, gulls, dabbling ducks, canvasbacks, ruddy ducks, common goldeneyes, and tundra swans. Northern harriers and red-tailed hawks are the most numerous raptors in corn, and blackbirds and American pipits are the most frequent landbirds.

Rice

Rice is a flood-irrigated crop of seed-producing annual grasses. It is maintained in a flooded state until near maturation. Rice is usually grown in areas that previously supported natural wetlands, and many wetland wildlife species use rice fields, especially waterfowl and shorebirds. Waste grain also provides food for species such as ring-necked pheasant, sandhill crane, and blackbirds. Other wildlife that use rice fields include garter snake, bullfrog, and wading birds (egrets, bitterns, and ibis) that forage on aquatic invertebrates and small vertebrates, such as crayfish and small fishes. Rice fields provide habitat for a range of wintering waterfowl species in the Yolo Bypass. In particular, the practice of flooding rice fields in winter to allow rice stubble to decompose, instead of burning it after harvest, provides loafing or foraging opportunities for a wide variety of ducks and geese, shorebirds, migratory and wading birds in fall and winter. Cranes forage in rice fields in the Delta (Ivey and Herziger 2003), but overall little has been published on bird use of rice fields in this region. There is extensive literature, however, on bird use of Sacramento Valley rice fields (e.g., Elphick and Oring 1998; Elphick 2008; Elphick et al. 2010).

Orchards

Orchards are habitats dominated by a single tree species. Trees are usually kept fairly low and bushy, with a mostly closed canopy and an open understory. Orchards usually are grown on fertile land that formerly supported diverse and productive natural habitats and wildlife. Recent expansion of orchards and vineyards has led to concerns about loss of habitat for cranes (Littlefield and Ivey 2000; Ivey and Herziger 2003); foraging habitat for raptors also would be reduced. Orchard habitats are used by several common woodland-associated species, such as western gray squirrel, American robin, American crow, western scrub-jay, red-tailed hawk, bats, and the nonnative black rat.

Vineyards

Vineyards consist of single-species vines grown in rows on trellises. Rows are normally formed by intertwining vines, with open spaces between the rows, and movement between rows is restricted. The spaces between rows either are barren soil or are composed of a cover crop of natural or exotic herbaceous plants. Vineyards are usually grown on fertile land that formerly supported diverse and productive natural habitats and wildlife. Except for some common species, such as mourning dove, and barn owls that use perches and nest boxes installed to attract raptors to control pest species, vineyards provide little wildlife habitat.

Other Cultivated Crops

Other cultivated crops include grain and seed crops, various row crops, and silage crops. Grain and seed crops are annual grasses that are grown in dense stands and include corn, wheat and barley, and others. Because the dense growth makes it difficult to move through these fields, most of the wildlife values are derived during the early growing period, and especially following the harvest, when waste grain is accessible to waterfowl and other birds, such as sandhill cranes. For example, winter wheat is used extensively by foraging waterbirds. Along with harvested corn, harvested and newly planted winter wheat fields are primary foraging areas for sandhill cranes in the Delta (Ivey and Herziger 2003). Winter wheat fields flooded after harvest are also used extensively by waterfowl, shorebirds, and waders. Newly planted winter wheat is also an important food resource in the Delta for grazing geese, particularly Aleutian cackling geese. In spring, wheat fields provide nesting cover for ring-necked pheasants, ducks, and other ground-nesting birds. In addition to their use of the crops mentioned above, sandhill cranes in the Delta also forage in asparagus, disked beans, tomatoes, safflower, and barley and in newly flooded fields regardless of crop type (Ivey and Herziger 2003).

Although generally of lesser value to wildlife than native habitats, row and silage crops often support abundant populations of small mammals, such as western harvest mouse and California vole. These species in turn attract predators such as gopher snake, western racer, American kestrel, and red-tailed hawk. Other reptile and bird species prey on the insect populations abundant in row crop and fields grown for silage, including western fence lizard, Brewer's blackbird, American crow, and the nonnative European starling.

4.3.2.3.11 Developed Lands

Additional lands in the Delta and Suisun Marsh that were not designated with a natural community type are characterized here as developed lands. Developed lands include lands with residential, industrial, and urban land uses, including landscaped areas, riprap, road surfaces, and other transportation facilities. Developed areas support some common plant and wildlife species. Their abundance and species richness vary with the intensity of development, with dense urban areas supporting less wildlife than less dense suburban settings. Suburban areas with mature trees (ornamental or native) can approximate a natural environment, and more native species may occur than in other urban settings. Bird species include house sparrow, house finch, western scrub-jay, European starling, mourning dove, Eurasian collared-dove, and rock dove in more urban zones, progressing to spotted towhee, bushtit, and California quail in more suburban environments.

Mammal species in urban residential areas include raccoon, opossum, and striped skunk, with black-tailed deer and black-tailed jackrabbit in more suburban to rural settings. California slender salamander, gopher snake, and western fence lizard could also occur in these areas.

4.3.3 Delta Watershed

This section describes the biological resources setting of the major tributaries to the Delta below their major dams. The description focuses on natural riparian and riverine communities and special-status species that occur in these communities because actions undertaken through implementation of the Delta Plan would most likely occur in and have the potential to affect these communities.

4.3.3.1 Sacramento River Watershed

This section describes the riparian and riverine natural communities and special-status species of the Sacramento River and its tributaries downstream of the major dams.

4.3.3.1.1 Riparian and Riverine Natural Communities

Vegetation along the Sacramento, Feather, and American rivers downstream of the major reservoirs consists primarily of different stages of riparian forest or scrub vegetation. The nature of the woody riparian vegetation along the water's edge depends on the geomorphic position of the river, the width of the riverbank, and the proximity of the primary levees protecting adjacent lands.

Sacramento River

The assessment area for the Sacramento River is from Shasta Dam downstream to the Sacramento-San Joaquin Delta. Within this long stretch of river, the following subsections (i.e., "reaches") are described below:

- Shasta Dam to RBDD
- RBDD to Colusa
- Colusa to the Delta

Shasta Dam to Red Bluff Diversion Dam

The reach extends from Shasta Dam downstream through the cities of Redding and Anderson, past Bloody Island, through Iron Canyon and the City of Red Bluff to the RBDD. Hydrology in this reach is highly influenced by the operation of the CVP. The operation of the CVP in this reach includes Shasta and Keswick dams on the mainstem of the Sacramento River, as well as the diversion of Trinity River and Clear Creek water to Keswick Reservoir via the Spring Creek tunnel. Central Valley Project operations reduce flood peaks during the winter and spring and increase discharges between floods during the summer and autumn. The effect of these changes to hydrology is most obvious directly below the dams. Because of the influence of tributaries with distance downstream, the hydrologic changes due to CVP operations are less pronounced in the lower reaches (SRCAF 2003, p. 3-5). The principal west side tributaries to the Sacramento River in the Keswick-Red Bluff Reach include Clear, Cottonwood, and Dibble creeks and the main east side tributaries are Churn, Stillwater, Cow, Bear, Ash, Battle, and Paynes creeks.

The CVP's Shasta Dam has significantly altered the hydrology of the Sacramento River. Water from the upper Sacramento River drainage is stored in Shasta Lake during the winter and spring months and released during the summer and fall. As a result, winter flows have been reduced and summer flows tend to be higher. Shasta Lake mostly impounds peak flood flows, resulting in smaller flood flows downstream. A large influx of water into the reservoir during a large storm and/or snowmelt occasionally may necessitate high volume releases. Fish migration upstream is blocked by Keswick Dam, and there are no anadromous fish species above this point on the Sacramento River. Anadromous fish found downstream of Keswick Dam include winter- and spring-run Chinook salmon, steelhead, green and white sturgeon, and lampreys. Trout and other native fishes are also found in this reach.

The reach between Keswick Dam and RBDD provides spawning habitat for Chinook salmon and steelhead. This reach was not historically utilized by winter-run Chinook salmon for spawning, but Keswick Dam precludes access to all historical spawning habitat for three populations of winter-run Chinook salmon (NMFS 2009a, p. 89). Spring-run Chinook salmon also spawn in this reach, although little spawning activity has been recorded in recent years (NMFS 2009a, p. 102). Recent stream surveys by USFWS and Reclamation have identified numerous holes and pools downstream of Keswick Dam to approximately GCID that would support spawning or holding activities for green sturgeon (NMFS 2009a, p. 127).

The Sacramento River from Shasta Dam to Red Bluff is mostly deeply entrenched in bedrock, which precludes development of extensive areas of riparian vegetation. Riparian forests are confined to narrow corridors at the base of canyon walls. The riparian woodlands along this reach of the river generally occur in narrow, discontinuous patches but provide overstory and midstory vegetation used for nesting and roosting by numerous raptors, including red-tailed hawk, barn owl, great horned owl, and American kestrel. The riparian woodlands also provide important nesting and foraging cover for resident, migratory, and wintering songbirds, such as western tanager and spotted towhee, and they support several species of common mammals, reptiles, and amphibians. Riparian scrub habitat also occurs in narrow or discontinuous patches but still provides important food, shelter, and breeding habitat for many of the same wildlife found in riparian woodland habitat; however, it typically lacks the overstory component that supports nesting by larger bird species. Wetland habitat is limited to confluences where tributaries enter the river or along the edges of the river.

Red Bluff Diversion Dam to Colusa

This reach extends from the RBDD downstream past the towns of Tehama, Los Molinos, Glenn, Butte City, and ends at Colusa Bridge in the City of Colusa. The hydrology of this reach has changed as a result of Central Valley Project operations as described above for upstream reaches. However, the hydrologic influence of the tributaries is quite strong in this reach (SRCAF 2003, p. 4-6). Major tributaries include Reeds, Antelope, Mill, Elder, Thomes, and Deer creeks.

This reach of the river marks the beginning of historical overflow into the Butte and Colusa basins and the gradual downstream development of natural levees. It is also the beginning of the Sacramento River Flood Control Project, which controls and directs overflows into the Sutter Bypass through a system of setback levees, overflow areas, and weirs. The hydrology of this reach has changed as a result of Sacramento River Flood Control Project operations. Downstream of Princeton and the Princeton Ferry, floodwaters are diverted out of the setback levee system into Butte Basin through the Moulton Weir. Further downstream, along the leveed portion of the Sacramento River, floodwaters are diverted eastward into the Sutter Bypass through Moulton, Colusa, and Tisdale Weirs (SRCAF 2003, p. 5-4).

Anadromous fish found downstream of RBDD include Chinook salmon, steelhead, green and white sturgeon, and lampreys. Trout and other native fish are also found in this reach. Winter- and spring-run Chinook salmon and steelhead primarily spawn in the reach above RBDD and tributaries to the Sacramento River, utilizing the reaches downstream of RBDD as a migration corridor as both adults and juveniles. Fall-run Chinook salmon and sturgeon can spawn in these downstream reaches where suitable habitat exists. Juvenile salmon, steelhead, sturgeon, pass through this reach on their downstream migration, feeding and rearing on their way to the ocean.

From Red Bluff to Colusa, the Sacramento River is classified as a meandering river, where relatively stable, straight sections alternate with more sinuous, dynamic sections (SRCAF 2003). The channel remains active and has the potential to migrate in times of high water. Point bars, islands, high and low terraces, instream woody cover, early successional riparian plant growth, and other evidence of river meander and erosion are common in this reach. Major physiographic features include floodplains, basins, terraces, active and remnant channels, and oxbow sloughs. These features sustain a diverse array of riparian plant assemblages. Riparian vegetation in this reach includes willow- and blackberry-dominated scrub and cottonwood- and willow-dominated forest communities present along active channels and on lower terraces, and valley oak–dominated woodland and forest communities occurring on higher terraces. Portions of the Sacramento River, especially from Red Bluff to Hamilton City, contain substantial remnants of the Sacramento Valley’s historical riparian forest. The floodplain shows a long history of erosion, deposition, and channel migration. The river has meandered over time throughout this reach and has deposited deep alluvial sediments.

In this reach, the riparian forest community supports most of the same wildlife species found in the upper section of the river. Species present in riparian and wetland habitat created by areas of backwater include wood duck, mallard, belted kingfisher, black phoebe, wading birds and shorebirds, and mammals such as river otter, mink, and muskrat.

Colusa to the Delta

This reach extends from Colusa, past the towns of Meridian, Grimes, and Knights Landing downstream to Collinsville at the confluence with the San Joaquin River. The character of the Sacramento River changes considerably near Colusa. Downstream of Colusa the gradient of the river decreases, the channel becomes narrower and deeper, its capacity smaller, and its bed material finer. The natural levees, which are discontinuous further upstream, are now continuous along both sides of the channel to the confluence with the Feather River (SRCAF 2003, p. 6-1). However, much of the land between the natural levees has been reclaimed through a system of levees, overflow weirs, outfall gates, pumping plants, bypass floodways, and overbank floodway areas as part of the Sacramento River Flood Control Project.

From Verona downstream to Collinsville at the confluence with the San Joaquin River, the river is narrowly constrained (except in the last few miles) by levees. Most of this reach is also influenced by tidal action during much of the year (USFWS 2004a, p. 9).

Anadromous fish found downstream of RBDD include Chinook salmon, steelhead, green and white sturgeon, striped bass, American shad, and lampreys. Rainbow trout, Sacramento splittail, and other native fish are also found in this reach. Winter- and spring-run Chinook salmon and steelhead primarily spawn in the reach above RBDD and tributaries to the Sacramento River, utilizing this reach as a migration corridor as both adults and juveniles. Fall-run Chinook salmon and sturgeon generally spawn in reaches further upstream or in the larger tributaries where more suitable habitat exists. Juvenile salmon, steelhead, sturgeon, pass through this reach on their downstream migration, feeding and rearing on their way to the ocean.

Downstream of Colusa, the general character of the Sacramento River changes markedly to a levee-confined, narrow channel restricted from migration. Surrounding agricultural lands extend to the levees, which have cut the river off from most of its historical floodplain, especially on the eastern side of the river. Most of the levees in this reach are lined with riprap, allowing the river no erodible bank substrate and limiting the extent of riparian vegetation (SRCAF 2003). In some areas upstream of Verona, levees are set back from the water's edge, affording some opportunities for the maintenance of larger areas of riparian habitat. Local reclamation districts maintain many of these areas. Examples of high-quality mature riparian habitat exist in the setback levee reaches. Downstream of Verona, the Sacramento River is narrowly confined by levees with much of the riparian habitat occurring as narrow bands along levees.

The Sacramento River enters the Delta below the community of Freeport in Sacramento County. During high flow events, the Yolo bypass redirects flood flows southwards through the flood bypass, around the reach of the Sacramento River that flows through the City of Sacramento, before discharging the water into Cache Slough near the southern tip of Liberty Island. Juvenile salmonids are known to use the Yolo bypass for rearing during these flood events and there is evidence of increased survival and growth (Sommer et al. 2001b, p. 325).

Near the town of Walnut Grove, two channels bifurcate from the main Sacramento River channel and flow southwards; one of which, the Delta Cross Channel, transports water from the Sacramento River into the interior Delta. Two radial gates are positioned at the head of the channel to block off flow into the channel as needed. When the radial gates are open, the net water flow moves southwards in the Delta Cross Channel, and into Snodgrass Slough and the Mokelumne River system (NMFS 2009a, p. 213). Juvenile salmonids emigrating down the Sacramento River may be diverted into the Delta Cross Channel and Georgiana Slough and enter the interior Delta, becoming vulnerable to entrainment by the export facilities. Therefore, the operation of the Delta Cross Channel gates may significantly affect the survival of juvenile salmonids emigrating from the Sacramento River basin towards the ocean (NMFS 2009a, p. 402). Adult migration into the Sacramento and Mokelumne rivers may also be adversely affected by operation of the Delta Cross Channel through false attraction and delayed migration (NMFS 2009a, p. 406).

Lower Feather River

The Feather River is a major tributary to the Sacramento River. The study area for the lower Feather River is from Oroville Dam (near the city of Oroville) downstream to the confluence with the Sacramento River near the town of Verona (DWR 2007a, p. 4.2-12).

Oroville Reservoir, operated by the California Department of Water Resources (DWR) and the keystone of the SWP, is the lowermost reservoir on the Feather River and the upstream limit for anadromous fish (USFWS 1995, p. 2-V-12). Water is released from Oroville Dam through a multilevel outlet to provide appropriate water temperatures for the operation of the Feather River Hatchery and to protect downstream

fisheries. Approximately 5 miles downstream from Oroville Dam, water is diverted at the Thermalito Diversion Dam into the Thermalito Power Canal, thence to the Thermalito Forebay and another powerhouse, and finally into the Thermalito Afterbay. The Oroville-Thermalito complex, completed in 1968, provides water conservation, hydroelectric power, recreation, flood control, and fisheries benefits (NMFS 2009b, p. 53). Hydrology in the lower Feather River is also influenced by operation of the Sutter Bypass, which brings Sacramento River water through Butte Slough and into the lower Feather River.

NMFS (2009a, p. 48 Figure 2-4) reported that four independent populations of spring-run Chinook salmon historically occurred in the upper tributaries (i.e., North, Middle and South forks, and the West Branch) of the Feather River watershed, but they are now extinct. A hatchery population currently occurs in the lower Feather River below Oroville Dam but there is considerable introgression between spring-run and fall-run populations within the Feather River system due to hatchery practices (NMFS 2009a, p. 95). A naturally spawning population of spring-run Chinook salmon currently is restricted to accessible reaches of the lower Feather River. Few wild steelhead are produced in the Feather River, mainly because of inadequate conditions for juvenile rearing (McEwan and Jackson 1996, p. 47).

The lower Feather River supports a variety of native and nonnative fish species. Common fishes include sturgeon, salmon, steelhead, Sacramento pikeminnow, catfish, carp, and bass. Special-status fish species include Chinook salmon, steelhead, green sturgeon, hardhead, and Sacramento splittail.

Riparian vegetation types along the Feather River downstream of Oroville Dam are similar to those along the Sacramento River in the reach between Red Bluff and Colusa. In many areas, however, the Feather River is constrained by levees, urbanization, or agriculture, and in these areas, riparian vegetation is only a thin band of trees, sometimes only one tree canopy wide with little to no understory. In areas where large meander bends persist, such as at Abbott Lake and O'Connor Lakes near the Lake of the Woods State Recreation Area, large expanses of riparian forests exist (DWR 2004b).

Some of the adjacent farmland is being restored to floodplain habitat with the relocation of levees to create setback levees. Wildlife habitat along the Feather River downstream of Oroville Dam to Verona is similar to that found along the Sacramento River between Red Bluff and Verona, and many of the same species are present. Much like on the Sacramento River, the riparian and wetland habitats on the Feather River are constrained by levees, agriculture, or urbanization but nevertheless are extremely important wildlife communities. The diversity and density of wildlife species associated with these ecosystems are disproportionately high in comparison with surrounding plant communities and enhanced where larger areas of riparian and backwater/wetland habitat are preserved.

Yuba/Bear Rivers

The Yuba River flows into the Feather River near the City of Marysville, about 39 river miles downstream of the City of Oroville. The study area for the Yuba River is from the confluence with the Feather River upstream to Englebright Dam, which blocks passage for all anadromous and resident fish species. Hydrology in the lower Yuba River is primarily controlled by Englebright Dam and Reservoir. Englebright Dam was built to keep upstream hydraulic gold mining debris out of the lower parts of the river (YCWA 2011) and now serves to regulate peaking power flows from the Colgate Powerhouse and to generate electrical power. The Yuba River supports highly valued populations of steelhead, resident rainbow trout, and fall-run Chinook salmon, as well as populations of other anadromous and resident fish communities.

The Bear River is the second largest tributary to the Feather River (Sacramento River Watershed Program 2010, p. 163), joining the Feather River about 55 river miles downstream of Oroville. The study area for the Bear River is from the confluence with the Feather River approximately 15 miles upstream to the South Sutter Irrigation District Diversion Dam, which blocks passage for all anadromous and resident fish species. The Bear River once supported substantial salmon and steelhead runs, but currently no self-sustaining salmon runs exist, and the status of steelhead is unknown (Sacramento River Watershed Program 2010, p. 165). However, the river does support a fishery for rainbow and brown trout.

Lower American River

The American River is the second largest tributary to the Sacramento River (Water Forum 2005, p. 11). The study area for the American River is from Folsom Dam downstream to the confluence with the Sacramento River. Folsom Dam and Reservoir are part of the federal Central Valley Project (CVP), which provides flood protection for the Sacramento area; water supplies for irrigation, domestic, municipal, and industrial uses; hydropower; water-related recreational opportunities; water quality control in the Delta; and maintenance of flows stipulated to protect fish and wildlife (Water Forum 2005, p. 10). Nimbus Dam is located approximately 7 miles downstream from Folsom Dam and serves as a regulating facility for hydropower releases from Folsom Dam. It also serves as a diversion dam for the Folsom South Canal. The lower American River is defined as the 23-mile reach of the river downstream from Nimbus Dam (Water Forum 2005, p. 10).

Hydrology in American River has been dramatically altered relative to unimpaired conditions. Annual peak flows historically occurred in the spring, but now occur in early winter. Historically, summer and early fall months were characterized by very low flows and high water temperatures. Summer flows are now higher and water temperatures are presently lower than they were historically (Water Forum 2001, p. 3-1). Flows in the lower American River are now more evenly distributed throughout the year because of the ability to store runoff and regulate flows, and make selective water temperature withdrawals from the penstock inlet ports at Folsom Dam.

More than 40 species of native and nonnative fish have been documented in the lower American River (Water Forum 2005, p. 12 Table 1). Several of these species are of concern to fisheries managers (DFG, NMFS, USFWS) because of their declining numbers or their importance to recreational and commercial fisheries: native Chinook salmon, steelhead, and Sacramento splittail, as well as nonnative American shad, and striped bass. Although the lower American River historically was not extensively used by anadromous salmonids for spawning, it now supports naturally spawning populations of fall-run Chinook salmon and steelhead due to changes in hydrology and water temperatures as a result of reservoir operations. Other native species that inhabit the lower American River are Sacramento sucker, Sacramento pikeminnow, sculpins (prickly and riffle), tule perch, hardhead, and Pacific lamprey (Water Forum 2005, p. 20). A naturally spawning population of nonnative American shad is found in the lower American River.

The lower American River downstream of Folsom and Nimbus dams is a fairly low-gradient waterway with established riparian forest similar to that described for the Sacramento and Feather rivers. Most of the lower American River is surrounded by the American River Parkway, which preserves the surrounding riparian zone. The river channel does not migrate to a large degree because it is deeply incised, leaving tall cliffs and bluffs adjacent to the river, in the upstream portion of the parkway. The lower 13 miles of the American River are controlled by levees. Although tall stands of Fremont cottonwood and other riparian trees are present, these species no longer have the opportunity to regenerate. The highly regulated flow regime no longer allows bank scour and sediment deposition, and gradually declining spring hydrographs required for regeneration of riparian species are absent.

Wildlife habitat in the riparian and wetland vegetation communities on the lower American River downstream of Folsom and Nimbus dams is similar to that described for the Sacramento and Feather rivers. The upper 2 miles of this reach, between Folsom Dam and Lake Natoma, is narrower and flanked by steep, rocky cliffs. Downstream of where the river enters Lake Natoma, the cliffs end, the wider and deeper lake is bordered by narrow bands of riparian woodland, and patchy areas of permanent freshwater marsh exist in shallow coves. These habitats support many of the same species already described, and the permanent wetlands also provide habitat for species such as Pacific chorus frog; western toad; common garter snake; raccoon; and several wading birds, such as herons, egrets, and American bittern. Substantial heron rookeries are also present in trees along the northwest shoreline of Lake Natoma.

4.3.3.1.2 Special-status Species

Six special-status plant species occur in riparian habitat of the Sacramento River watershed. Four of those species also occur in the Delta. Fox sedge, rose mallow, Sandford's arrowhead, and Wright's trichocoronis are either known to occur or have potential to occur in the Delta. Silky cryptantha and Columbian watermeal, which have not been discussed previously, are the two remaining species that could be present in the bankfull or drawdown zone. Silky cryptantha, a small herb in the Borage family, is on CNPS list 1B.2 and can be found on gravelly streambeds in riparian floodplains in the Sacramento River watershed. Columbian watermeal, a small floating aquatic species in the Duckweed family, is on CNPS list 2.2 and can be found in open water habitats in the upper Sacramento River watershed.

With the exception of delta smelt and longfin smelt, all special-status fishes found in the Delta also occur in the Sacramento River watershed. Of the 11 special-status wildlife species that have the potential to occur in riparian habitat of the Sacramento River watershed, 10 also occur in the Delta. Western pond turtle, valley elderberry longhorn beetle, Cooper's hawk, great egret, great blue heron, bald eagle, black-crowned night-heron, osprey, double-crested cormorant, and bank swallow are discussed in Table 4-2 or in separate species accounts that can be found in Appendix F-4. The one species that has the potential to occur in the Sacramento River watershed riparian habitat but that does not occur in the Delta is the foothill yellow-legged frog, which is a California species of special concern that occurs in perennial rocky streams in a wide range of deciduous and coniferous habitats and is rarely found far from permanent water. In the Sacramento River watershed, foothill yellow-legged frogs are documented at numerous locations upstream of the confluences of mainstem and smaller tributary streams entering Shasta Lake and at several locations downstream of the Shasta Dam on the mainstem of the Sacramento River.

4.3.3.2 Eastside Tributary Watershed

This section describes the riparian and riverine natural communities and special-status species for the eastside tributary rivers downstream of their major dams, including the Cosumnes, Mokelumne, and Calaveras rivers.

4.3.3.2.1 Riparian and Riverine Natural Communities

This section describes the riparian and riverine natural communities along the eastside tributary rivers.

Cosumnes River

The Cosumnes River is tributary to the Mokelumne River, joining from the north near the town of Thornton. There are no water storage reservoirs on this system, and, because of the low elevation of its headwaters, the river receives most of its water from rainfall (USFWS 1995, p. 2-V-14). The lower reaches of the river provide salmon spawning habitat, although anadromous fish access is limited to river reaches downstream of Latrobe Falls. The Cosumnes River may provide important non-natal rearing habitat for Central Valley steelhead from the Mokelumne River or other nearby steelhead producing rivers (NMFS 2009b, p. 6). More than 35 species of native and nonnative fish have been documented in the Cosumnes River (Cosumnes River Preserve 2011). Native species include Chinook salmon, California roach, hitch, Sacramento pikeminnow, Sacramento splittail, Sacramento blackfish, and Sacramento sucker. Nonnative fishes include bullhead, crappie, bass, and catfish.

Agricultural and urban land uses have encroached on the major eastside tributaries to the Delta (Cosumnes, Mokelumne, and Calaveras rivers), limiting the development of riparian habitat. The Cosumnes River is unique in that it is the only major river in the Central Valley without a major dam (two small dams are located near Rancho Murieta). At the downstream portion of the Cosumnes River, the Cosumnes River Preserve protects extensive riparian forest and floodplain habitats, with freshwater marshes and seasonal wetlands. These habitats support numerous plant and wildlife species. On the preserve, 230 plant species and 150 bird species have been identified (Cosumnes River Preserve 2011).

Mokelumne River

The Mokelumne River is a major tributary to the Delta, entering the lower San Joaquin River northwest of Stockton. Runoff in the watershed is captured in three major impoundments (Camanche, Pardee, and Salt Springs reservoirs) Camanche Reservoir together with Pardee Reservoir are operated as part of an integrated system, and water releases are used to meet various demands for downstream users, including storage regulation for flood control and for the Mokelumne River Fish Hatchery, hydroelectric generation, and instream flow requirements for salmon (The Trust for Public Land 2011, p. 104).

Five species of anadromous fish are present in the Mokelumne River below Camanche Dam, including fall-run Chinook salmon, steelhead, American shad, striped bass (USFWS 1995, p. 2-V-14) and Pacific lamprey. Fall-run Chinook salmon and steelhead are the primary management focus in the river (EBMUD 2008, p. 2-1). Steelhead historically occurred in the Mokelumne River, but native steelhead are believed to be extinct (USFWS 1998b, p. 4-65). Steelhead are now maintained in the river by hatchery releases (Marsh 2007, p. 6).

Merz and Saldate (2004, p. 1, Table 1) documented 38 species (12 native; 26 introduced) of fish in the lower Mokelumne River. Native species include Chinook salmon, prickly sculpin, Sacramento sucker, steelhead, hitch, Sacramento pikeminnow, tule perch, and Pacific lamprey. Nonnative fishes include western mosquitofish, golden shiner, threadfin shad, bluegill, inland silverside, shad, carp, bullheads, and bass.

The variety of riparian habitats along the Mokelumne River supports numerous bird species. During surveys in 1999 and 2000, 120 species of birds were observed between Camanche Dam and the confluence of the Mokelumne River and San Joaquin River (Smith 2004). Patches of fairly well developed riparian forest occur intermittently along the lower Mokelumne River.

Calaveras River

The Calaveras River is a relatively small Sierra Nevada watershed in the San Joaquin River system, located between the Mokelumne and Stanislaus rivers. Because of the lack of high elevation areas capable of holding snowpack, the Calaveras River watershed is a rain-driven system unlike other surrounding watersheds (NMFS 2009b, p. 201).

Streamflow in the lower watershed is controlled by releases from New Hogan Reservoir, a U.S. Army Corps of Engineers (USACE) flood control and water supply reservoir formed by New Hogan Dam, located 38 miles upstream from the mouth of the river (USFWS 2003, p. 4). Prior to construction of New Hogan Dam, the hydrology of the Calaveras River exhibited higher flow during the winter and spring, as well as periods of low-to-no flow during the late summer and fall. Since New Hogan Reservoir was constructed, winter and spring flow peaks have been reduced and water now flows year round between New Hogan Dam and Bellota Weir (Marsh 2006, p. 7).

Anadromous fish have access to 36 miles of the Calaveras River between New Hogan Dam and the San Joaquin River, when flows permit (Marsh 2006, p. 7). Eighteen river miles upstream from the mouth, Bellota Weir splits the Calaveras River into two channels: Mormon Slough and the Old Calaveras River channel. Mormon Slough and the Stockton Diverting canal downstream are the primary channels used by migrating anadromous fish to access upstream spawning areas. Following the end of the irrigation season, fall flows in Mormon Slough, may prevent spawning migration (FFC 2004, p. 10). Mormon Slough, the primary salmonid migration channel, still experiences dry periods during summer and early fall as it did under the unregulated hydrologic regime (Marsh 2006, p. 8).

A small, apparently self-sustaining population of steelhead exists in the Calaveras River (NMFS 2009a, p. 107). Surveys over the past several years indicate that small numbers of steelhead continue to run up the river with the first fall rains and during the winter (USFWS 2003, p. 10). Chinook salmon have not been observed in the Calaveras River since 1984 (USFWS 1995, p. 2-V-18).

More than 20 species of resident fish and migratory anadromous fish inhabit the Calaveras River (DWR 2007c, p. 3-1). Native species include Chinook salmon, Sacramento pike-minnow, and other minnows. Nonnative fishes downstream of New Hogan Dam include American shad, sunfish, catfish, and several species of bass.

The lower Calaveras River descends through oak woodlands and grassland after it exits New Hogan Reservoir in the foothills of Calaveras County. Substantial gravel mining pits exist along the lower Calaveras River. Much of the length of the Calaveras River has been channelized, and a portion of the flow is routed through Mormon Slough, a flood control channel. Riparian vegetation along the lower Calaveras River tends to be narrow. The lowest portion of the river runs through the city of Stockton and supports riparian trees only intermittently.

4.3.3.2.2 Special-status Species

Several of the special-status fishes found in the Delta also are found in one of more of the Eastside Tributaries, including Chinook salmon, steelhead, river lamprey, hardhead, and splittail. Special-status plant and wildlife species found in the riparian habitat along the lower Cosumnes, lower Mokelumne, and lower Calaveras rivers generally include the same species found in the riparian habitats of the Delta., such as valley elderberry longhorn beetle, Swainson’s hawk, bank swallow, tricolored blackbird, Cooper’s hawk, and yellow-breasted chat (Smith 2004, Table 3, p. 16). Littlefield and Ivey (2000) reported four roost sites for greater sandhill crane along the Cosumnes River. The Cosumnes River Preserve supports several known occurrences of special-status species, including dwarf downingia, legenere, California tiger salamander, western spadefoot, giant garter snake, western pond turtle, Swainson’s hawk, burrowing owl, and heron and egret rookeries (Cosumnes River Preserve 2011).

4.3.3.3 San Joaquin River Watershed

This section describes the riparian and riverine natural communities, and special-status species for the San Joaquin River and its tributary rivers downstream of their major dams.

4.3.3.3.1 Riparian and Riverine Natural Communities

This section describes the biological resources setting for the San Joaquin River watershed upstream of the Delta. Aquatic and riparian communities are discussed in greatest detail, with additional discussion of terrestrial biological resources of the valley floor (up to 300 feet in elevation) and of the foothills and montane communities.

Rivers of the San Joaquin River watershed include the mainstem San Joaquin River and its major tributaries. The San Joaquin River drains west from the Sierra Nevada, turns sharply north at the center of the valley floor, and flows north through the valley into the Sacramento-San Joaquin Delta. On the west side of the basin, relatively small intermittent streams drain the eastern flanks of the Coast Range but rarely reach the San Joaquin River (USFWS 1995, p. 2-V-15). The major eastside tributaries south of the Delta are the Stanislaus, Tuolumne, and Merced rivers.

Major reservoirs in the San Joaquin River watershed include New Melones Reservoir, Don Pedro Reservoir, Lake McClure, and Millerton Lake. Natural communities in the drawdown zones of the major reservoirs are similar to those described above for reservoirs in the Sacramento River watershed. Much of the reservoirs' sides are steep and rocky, with little soil. The upper reaches of the reservoirs are located in deeply incised canyons. The frequently fluctuating water levels of the reservoirs and the associated drying and inundation cause any vegetation that establishes to be seasonally flooded or to dry out. Wave action from recreational boat use may also result in erosion that hinders plant establishment. The overall result is that the reservoir shorelines and drawdown zones are predominantly bare soil and rock.

The areas where annual herbaceous vegetation is able to establish is best characterized as seasonal wetland dominated by species such as bog yellowcress and cocklebur. The seasonal wetland is supported by low-relief shoreline areas that vary in the timing and magnitude of inundation. The low-relief areas are natural basins associated with tributary channels, former floodplain, and lower hillslope or shoreline positions. Around Millerton Lake, dense stands of Santa Barbara sedge and creeping wildrye grow near the top of the inundation zone only in the vicinity of tributary streams, such as Big Sandy Creek. Narrow bands of willow and alder riparian shrub vegetation may also be found.

Wildlife species and habitat along the inundation zone of the major reservoirs in the San Joaquin River watershed are similar to those described for the lakes and rivers in the Sacramento River watershed. Limited shoreline habitats, combined with the nearshore open water, provide foraging and resting habitat for a variety of waterfowl and shorebirds, such as ruddy duck, ring-necked duck, mallard duck, grebe, and coot. Several fish-eating bird species, such as grebes, forage in the open water; other species, such as ducks, herons, and egrets, dabble or hunt along the shallow shoreline for seeds, invertebrates, and small fish. Riparian habitat that provides important nesting and foraging cover for resident, migratory, and wintering birds and that supports various mammals, reptiles, and amphibians mainly exists upstream of the confluences of mainstem and smaller tributary streams.

Lower San Joaquin River

The study area for the lower San Joaquin River is from Friant Dam downstream to the Delta. Within this long stretch of river, the following reaches are described below:

- Friant Dam to the confluence with Merced River
- Merced River to the Delta

Friant Dam to Merced River

The aquatic environment of the upper San Joaquin River, from the Merced confluence upstream to Friant Dam, has been significantly altered over the past century due to changes in land and water use. The historical population of Central valley spring-run salmon in the San Joaquin River was extirpated due to several changes caused by development, including the building of Friant dam that blocked fish passage to upper San Joaquin River habitats and major agricultural water diversions which lowered the quantity and quality of water and caused areas of entrainment (NMFS 2009b, p. 235). The extent to which steelhead use this section of river is not well known.

As a direct result of a settlement reached in September 2006 on an 18-year lawsuit, the San Joaquin River Restoration Program (SJRRP) was initiated to restore flows to the San Joaquin River from Friant Dam to the confluence of Merced River and restore a self-sustaining Chinook salmon fishery in the river while reducing or avoiding adverse water supply impacts from restoration flows (Reclamation and DWR 2011). Spring-run Chinook salmon could be restored to this section of the river as early as 2012 (Reclamation and DWR 2011).

The San Joaquin River downstream of Friant Dam is initially confined by tall bluffs, but from approximately 30 miles downstream of Friant Dam, the river becomes largely confined within levees and bounded by agricultural and urban development. Flows are regulated through dams and diversions, and floodplain habitats have been fragmented and reduced in size and diversity. As a result, the riparian communities and associated wildlife have substantially changed from historic conditions (Reclamation 1998).

The presence of Friant Dam reduces the frequency of scouring flows, which has resulted in a gradual decline of bare gravel and sand bar surfaces. Over time, under these conditions, the vegetation succession of riparian scrub to forest is no longer balanced by periodic loss of forest to the river because of erosion and the appearance of new riparian scrub on sand and gravel bars. In addition, operation of Friant Dam has altered the natural regime of gradually declining flows in spring, which are periodically necessary to disperse seed of willows and cottonwoods and establish seedlings of these riparian tree and shrub species. The diversion of water has resulted in a loss of riparian vegetation in several reaches of the river, while urban and agricultural development has reduced the area available for riparian habitat (Reclamation 1998).

Existing vegetation types likely to be found along the San Joaquin River include riverwash, herbaceous riparian vegetation and marsh, riparian scrub, cottonwood riparian, and mixed riparian forest. Riverwash consists of alluvial sands and gravel associated with the active channel of the San Joaquin River. Generally, riverwash areas exist as sand and gravel point bars in the floodplain of the river. The scattered vegetation on riverwash and other exposed areas provides nesting habitat for shorebirds, such as killdeer, black-necked stilt, and American avocet. Other species, such as mallard ducks, may use riverwash habitats for roosting or resting.

Herbaceous riparian vegetation and marsh cover types have two distinct components: (1) a terrestrial component composed of annual and perennial herbaceous vegetation found on mesic (moist) sites in the floodplain of the river and (2) an aquatic component (tule and cattail marsh) dominated by marsh vegetation. Characteristic herbaceous riparian species found along the San Joaquin River are Bermuda grass, sunflower, cocklebur, goosefoot, and beggar’s tick. Characteristic marsh species are bulrushes and cattails (Moise and Hendrikson 2002).

Marshes along the edges of the low-flow channel and in backwaters and sloughs can be extensive in downstream areas and support an array of wildlife. Species such as song sparrow, common yellowthroat, marsh wren, red-winged blackbird, and Virginia rail are present in this habitat during the nesting season and, in some cases, throughout the year. Mammal species that use this habitat include California vole, muskrat, and Norway rat. Pacific chorus frog, bullfrog, and western terrestrial garter snake are common amphibians and reptiles found in this habitat.

Riparian scrub vegetation is found on sand and gravel bars in the more disturbed areas of the open channel. These sites are subject to deeper flooding and higher flows, which bury and break woody stems. Goodding's black willow and narrow-leaved willow are able to bend with the flows and recover or to re-sprout from the base. They are the most common dominants, with the narrow-leaved willows frequently forming dense clonal stands. Cottonwood seedlings are usually present but rarely reach reproductive size (Moise and Hendrikson 2002).

Typical bird species found in riparian scrub habitat include western wood-pewee, black phoebe, yellow-billed magpie, bushtit, Bewick's wren, lazuli bunting, blue grosbeak, and American goldfinch. Mammal species using scrub habitats include coyote, raccoon, desert cottontail, and striped skunk.

Cottonwood riparian forest is a dense, broad-leaved deciduous forest found on fine-grained alluvial soils that are usually flooded yearly. Dominant species are Fremont cottonwood and Goodding's black willow; other willow species include red willow and arroyo willow. Box elder and ash are also commonly found in this vegetation type.

Mixed riparian forest forms under conditions of less disturbance/flooding than the cottonwood riparian communities, usually located farther back from the active channel. Dominants change along the river, with some areas heavily dominated by ash, whereas others are mixed. Willows are usually present, and other species include valley oak, black walnut, alder, sycamore, and cottonwood in various proportions. Vegetation is typically dense. This type is most common along the upper reaches of the river (Moise and Hendrikson 2002).

The larger, mature mixed riparian forest stands along the San Joaquin River once supported the most dense and diverse breeding bird communities in California (Gaines 1974) and still provide high-quality nesting habitat for raptors, such as red-tailed hawk and red-shouldered hawk. They also provide nesting habitat for cavity-nesting species, such as downy woodpecker, wood duck, northern flicker, ash-throated flycatcher, oak titmouse, and white-breasted nuthatch. In addition, the extensive marshes produce populations of insects that feed on foliage and stems during the growing season and act as prey for these and other migratory and resident birds, such as the Pacific-slope flycatcher, western wood-pewee, olive-sided flycatcher, warbling vireo, and Bullock's oriole. Mammal species using riparian forests are similar to those described previously for scrub habitats.

Merced River to the Delta

The San Joaquin River enters the Delta at Vernalis which is widely used as a monitoring point for Delta inflows and standards. Flows in the lower San Joaquin River are primarily governed by the tributary inflows from the Merced, Tuolumne, and Stanislaus rivers (Reclamation and SJRGA 2001, Section 4.1.3). In this reach, levees confine the river on both sides and have limited the extent of available floodplain, wetland, or shaded riverine habitat. On the west side, virtually all land adjacent to the river is under intensive agricultural development (Reclamation and SJRGA 1999, p. 3-66).

As described above, the historic run of spring-run Chinook salmon in the San Joaquin basin was extirpated. However, fall-run Chinook salmon and steelhead continue to migrate through this reach as adults to reach their spawning grounds in the Stanislaus, Tuolumne, and Merced rivers. Juveniles also pass through this reach on their seaward migration. American shad and striped bass migrate from the Pacific Ocean via the Delta into the San Joaquin River to spawn in the spring. Sacramento splittail,

Sacramento pikeminnow, and other native species are also found in the lower San Joaquin River. However, this reach is dominated by introduced species such as largemouth bass, bluegill, green sunfish and western mosquitofish (Brown and Moyle 1993, p. 103 Table 3).

The San Joaquin River downstream of the Merced River confluence is similar to the river upstream of the confluence, except that the Merced, Tuolumne, and Stanislaus rivers contribute a substantial amount of flow. Agricultural land use has encroached on the riparian habitat along most of the river. Along much of the river in this reach, only a narrow ribbon of riparian habitat occurs. However, riparian habitat is more extensive locally, especially near the confluence with tributary rivers, in cutoff oxbows, and in the 6,500-acre San Joaquin River NWR between the confluences with the Tuolumne and Stanislaus rivers. Remnant common tule- and cattail-dominated marshes may occur at these areas (Nature Conservancy 2001).

San Joaquin River Tributaries

Major tributaries to the San Joaquin River include the Merced, Tuolumne, and Stanislaus rivers. The riparian habitat along the major tributaries is similar to that of the San Joaquin River below Millerton Lake, except that it is generally narrower along the tributaries because of agricultural encroachment; riparian habitat is more extensive in the 258-acre Caswell Memorial State Park, which supports an old riparian forest with large oak trees on natural levees (Nature Conservancy 2001). Another unique riparian community is formed by sycamore alluvial woodland along Orestimba Creek (Nature Conservancy 2001). Riparian habitat along the main stem of the San Joaquin River and its major tributaries has been reduced by aggregate mining, which has left major instream pools. These areas can be affected by especially dense stands of invasive riparian species, such as the stands of red sesbania found around the gravel ponds in the San Joaquin River near Fresno (Hunter and Platenkamp 2003).

Wildlife habitat associated with riparian and wetland vegetation in the bankfull zone of the major tributaries is similar to that described for the San Joaquin River below Millerton Lake.

Merced River

The Merced River is tributary to the San Joaquin River in the southern portion of California's Central Valley. The Merced River originates in Yosemite National Park and flows down the western slope of the Sierra Nevada range into the Central Valley, joining the San Joaquin River about 87 miles south of Sacramento, California. Four mainstem dams affect flow conditions in the lower Merced River. The two largest dams are New Exchequer Dam (which impounds Lake McClure) and McSwain Dam (which impounds Lake McSwain) (USFWS 1995, p. 2-V-16; Stillwater Sciences 2002, p. 3-8). The study area for the Merced River is from New Exchequer Dam downstream to the confluence with the San Joaquin River.

Historically, the Merced River supported spring- and fall-run Chinook salmon, and occasionally steelhead. Over time, the manipulation of the Merced River has led to loss and degradation of habitat for these native species. The dams block access to spawning grounds upstream and gravel recruitment is greatly reduced in reaches below the dams (NMFS 2009b, p. 232). Despite the loss and degradation of riverine habitat, the Merced River supports a population of fall-run Chinook salmon, and steelhead sporadically use the Merced River for spawning and rearing (NMFS 2009b, p. 232). Crocker-Huffman Dam presents an impassable barrier to upstream migration, and marks the upstream extent of currently accessible salmonid habitat. Salmon spawn in the 24-mile reach between Crocker-Huffman Dam and the town of Cressy (USFWS 1995, p. 2-V-16). Rearing habitat extends downstream of the spawning reach to the confluence with the San Joaquin River (USFWS 1995, p. 2-V-16).

Twenty-nine fish species were identified in the lower Merced River during seasonal surveys conducted from 2006 to 2008. Of these, 26 were resident species common to the region, and three were anadromous species (Stillwater Sciences 2008, p. 7-15, Table 7-7). DFG and MID have operated rotary screw traps for outmigrating salmon that provide incidental information on other fish species occurring in the river. Thirty-seven fish species have been captured in the rotary screw traps (Stillwater Sciences 2002, p. 3-55 Table 3-7). Besides Chinook salmon and steelhead, native species observed include Sacramento sucker, Sacramento splittail, hardhead, Sacramento pikeminnow, prickly sculpin, and lampreys. Nonnative fishes include western mosquitofish, threadfin shad, sunfish, inland silverside, striped bass, American shad, common carp, bullheads, and bass.

Tuolumne River

The Tuolumne River is the largest tributary in the San Joaquin River basin. Upstream salmon migration on the Tuolumne River is blocked by LaGrange Dam, which is located about 50 miles upstream of the confluence with the San Joaquin. La Grange Dam serves to regulate outflows from New Don Pedro Dam about two miles upstream and to divert outflows from Don Pedro Reservoir into canals on both sides of the river. The study area for the Tuolumne River is from New Don Pedro Dam downstream to the confluence with the San Joaquin River.

The Tuolumne River once supported populations of both spring- and fall-run Chinook salmon. Spring-run Chinook salmon were extirpated from the San Joaquin Drainage by the late 1940s (Yoshiyama et al. 1998, p. 507). Steelhead probably existed in the Tuolumne River in the past. However, in recent years, a few confirmed reports of steelhead in the San Joaquin River drainage have been received, suggesting a viable but very small population (USFWS 2004b, p. 5).

Besides Chinook salmon, Ford and Brown (2001, p. 270 Table 9) documented 33 species (12 native; 21 introduced) of fish in the lower Tuolumne River. Native species included rainbow trout, Sacramento sucker, steelhead, Sacramento splittail, hardhead, hitch, Sacramento pikeminnow, tule perch, and Pacific lamprey. Nonnative fishes included western mosquitofish, minnows, threadfin shad, bluegill, inland silverside, striped bass, common carp, bullheads, and bass.

Stanislaus River

The Stanislaus River is the northern most major tributary to the San Joaquin River. Significant changes have been made in the basin hydrology since agricultural development began in the 1850s. New Melones Dam, completed by the USACE in 1978 is the largest storage reservoir in the Stanislaus basin (USFWS 1995, p. 2-V-17). The New Melones project is operated by Reclamation as part of the CVP. Downstream from New Melones Dam, Tulloch Reservoir regulates water releases from New Melones Dam. Goodwin Dam, downstream of New Melones and Tulloch dams, regulates releases from Tulloch Reservoir and diverts water for power. Goodwin Dam is the upstream barrier for salmon migration. The study area for the Stanislaus River is from New Melones Dam downstream to the confluence with the San Joaquin River.

Historically, spring-run Chinook salmon were believed to be the primary salmon run in the Stanislaus River, but the fall-run population became dominant following construction of Goodwin Dam, which blocked upstream migration (Yoshiyama et al. 1996, p. 16; NMFS 2009a, p. 197). Central Valley steelhead were thought to be extirpated from the San Joaquin River system. However, monitoring has detected small self-sustaining (i.e., non-hatchery origin) populations of steelhead in the Stanislaus River and other streams previously thought to be devoid of steelhead (McEwan 2001, p. 15). Steelhead smolts have been captured in rotary screw traps in the lower Stanislaus River in most years (Demko et al. 2000, Figure 15; Watry et al. 2007, Figure 1.16).

In addition to Chinook salmon and steelhead, Watry et al. (2007, Appendix 2; Anderson et al. 2007, Appendix 2) identified 27 incidental species (9 native, 18 nonnative) of fish in the lower Stanislaus River. Native fishes observed include hardhead, hitch, Sacramento pikeminnow, Sacramento sucker, Sacramento blackfish, tule perch, and lampreys. Nonnative fishes observed include western mosquitofish, inland silversides, striped bass, bullheads, and bass.

4.3.3.3.2 Special-status Species

Three special-status plant species are found in the riparian community along the main stem of the San Joaquin River and the major tributaries: delta button celery, Sanford's arrowhead, and Wright's trichocoronis. These species are also known to occur or have potential to occur in the Delta. They are discussed in more detail in Table 4-1 or in separate species accounts in Appendix F-3.

Several special-status fishes occur in the watershed, including Chinook salmon, steelhead, river lamprey, Sacramento splittail, and hardhead. Nine special-status wildlife species occur in riparian habitat along the San Joaquin River and its major tributaries. Eight of these species also occur in the Delta. Western pond turtle, valley elderberry longhorn beetle, great egret, great blue heron, snowy egret, bald eagle, osprey, and bank swallow are discussed in Table 4-2 or in separate species accounts in Appendix F-3. The one species that has the potential to occur in the riparian habitat of the San Joaquin River watershed but that does not occur in the Delta is the foothill yellow-legged frog.

Alkali seasonal wetlands in the San Joaquin Valley support numerous rare plants, including heartscale, alkali milk-vetch, Lost Hills crownscale, and lesser saltscale. Vernal pools also support special-status plants, such as succulent owl's clover, San Joaquin Valley Orcutt grass, and vernal pool smallscale, as well as special-status crustaceans, such as vernal pool tadpole shrimp and vernal pool fairy shrimp. Grasslands and upland scrub in the San Joaquin Valley support a number of special-status species. These species include plants such as Kern mallow and California jewelflower and wildlife such as San Joaquin kit fox, giant kangaroo rat, Tipton's kangaroo rat, Fresno kangaroo rat, blunt-nosed leopard lizard, and Le Conte's thrasher (USFWS 1998a).

4.3.3.4 San Pablo Bay

San Pablo Bay is a tidal estuary that forms the northern extension of San Francisco Bay. It is located to the southwest of the study area and is hydrologically "downstream" of the Delta and Suisun Marsh. and receives water from the Sacramento and San Joaquin rivers, via Suisun Bay and Carquinez Strait on its northeast end, and is connected to the Pacific Ocean via San Francisco Bay on its southern end. San Pablo Bay also receives water from Sonoma Creek through the Napa Sonoma Marsh; San Rafael Creek and the Petaluma River directly; and the Napa River which flows into Carquinez Strait near its entrance into the bay. Most of San Pablo Bay is shallow; however, there is a deep water channel approximately in mid bay, which allows access to Sacramento, Stockton, Benicia, Martinez, and other smaller Delta ports. All of the tributaries except for Sonoma Creek are commercially navigable and maintained by the USACE. Within San Pablo Bay, much of the shoreline area is undeveloped, with many salt marshes and mudflats. In general, the natural communities described above for the Delta and Suisun Marsh are also found in San Pablo Bay. The bay is a wintering stop for waterfowl and other migratory species along the Pacific Flyway. Much of the northern shore of the bay is protected as part of the San Pablo Bay National Wildlife Refuge. Special-status species that are found in the bay include the California brown pelican, California clapper rail, salt marsh harvest mouse, and green sturgeon. Chinook salmon and steelhead must migrate through San Pablo Bay on their way to and from the Pacific Ocean.

4.3.3.5 San Francisco Bay

For purposes of this document, San Francisco Bay is defined as the estuary lying between San Pablo Bay and the Golden Gate Bridge. This includes two major embayments – the Central Bay and the South Bay. The South Bay receives little freshwater discharge, resulting in high salinity and low circulation (high residence time). It also has more extreme tides. The Central Bay, which receives Delta outflows, has less extreme tides and more marine conditions. The South Bay is shallow, having an average depth of 10 to 13 feet, but is incised by deep, narrow channels (typically 30 to 65 ft deep) maintained by river and tidal scouring; the Central Bay, is comparatively deep with an average depth of about three times that of the South Bay (The Bay Institute 1998, p. 2-77). The Central Bay also contains large islands that are not found in the South Bay.

Both the South Bay and Central Bay contain a large central expanse of open water overlying subtidal sediments, bordered by intertidal mudflats and marshes. Natural communities in the Bay include tidal open water, tidal mudflats, tidal marshes with a range of salinities from essentially fresh water to nearly fully marine, and rocky intertidal areas. San Francisco Bay is home to many resident and migratory fish species including salmon, sturgeon, Pacific herring, northern anchovy, starry flounder, surfperches, sharks, and rays as well as a wide variety of birds (California least tern, California clapper rail, California brown pelican), mammals (salt marsh harvest mouse), and marine mammals (sea otters, harbor seals).

4.3.3.6 Refuges

Reclamation has entered into long-term water supply contracts/agreements with USFWS and DFG, pursuant to sections 3406(d)(1) and 3406(d)(2) of Title 34 of Public Law 102-575, otherwise known as the Central Valley Project Improvement Act (CVPIA). These sections of the CVPIA require the provision of firm water supplies to specified National Wildlife Refuges (NWR), State Wildlife Areas (WA), and private wetlands in the Grassland Resource Conservation District (RCD). Firm water supplies allow for optimum habitat management on the existing refuge lands.

The long-term agreements implemented in accordance with sections 3406(d)(1) and 3406(d)(2) of the CVPIA require the Secretary of the Interior to provide specific quantities of water to the refuges. The CVPIA indicates that long-term contractual agreements should be developed for water provided under section 3406(d)(1). The water supplies required under section 3406(d)(1) are for Level 2 supplies, as defined in the *1989 Report of Refuge Water Supply Investigations* as current average water delivery (Reclamation 1989, Table II-2). The CVPIA requires delivery of this water in all year types except critically dry water-year conditions, as determined by Reclamation for allocation of CVP water. In the case of a critically dry water year, the Secretary of the Interior may reduce the Level 2 refuge water supplies by up to 25 percent. Section 3406(d)(2) of the CVPIA refers to Level 4 refuge water supplies, which is the amount of water required for optimum habitat management of the existing refuge lands identified in Reclamation (1989, Table II-2). Table 4-5 identifies the refuge areas discussed in this Environmental Impact Report (EIR), their acreage, and their Level 2 and Level 4 water supply needs.

4.3.3.6.1 Sacramento Basin Refuges

Several federal NWRs and State WAs occur in the Sacramento Valley. Four NWRs are located in the Sacramento River Basin, in Glenn, Colusa, and Sutter counties. These NWRs are managed collectively by USFWS as the Sacramento National Wildlife Refuge Complex. DFG manages Gray Lodge WA in Sutter and Butte counties, also in the Sacramento River Basin. Waterfowl are present from September through March in these refuges, including hundreds of thousands of geese and ducks from November through January. Many other species of birds and mammals are found throughout the year. These five refuge areas were created to provide habitat for migratory waterfowl of the Pacific Flyway and now serve a variety of wildlife and conservation objectives (Reclamation et al. 2001a, p. 2-2.):

- Provide a diversity of wetland habitats for an abundance of migratory birds, particularly waterfowl and water birds
- Provide a natural habitat and management to restore and perpetuate endangered, threatened, and proposed species, as well as species of special concern
- Preserve a natural diversity and abundance of flora and fauna
- Alleviate crop depredation on private lands by providing sufficient alternative food sources for waterfowl on refuge property
- Provide opportunities for the understanding and appreciation of wildlife ecology and the human role in the environment
- Provide high-quality wildlife-dependent recreation, education, and research

Sacramento National Wildlife Refuge

The Sacramento NWR contains more than 10,000 acres of permanent ponds, seasonal wetlands, irrigated moist soil units, and uplands in the heart of the Sacramento Valley. The wetlands support watergrass and invertebrate populations that serve as a food source for migratory waterfowl. Upland areas of the refuge are managed to provide habitat for geese, upland birds, and other wildlife species (Reclamation 1992, p. III B-1). It is one of California's premier waterfowl refuges.

Delevan National Wildlife Refuge

The Delevan NWR contains more than 5,700 acres of permanent ponds, seasonal wetlands, watergrass fields, and uplands. The wetlands produce waterfowl food, such as swamp timothy, watergrass, and invertebrate populations. The upland areas of the refuge provide habitat for geese, upland birds, and other wildlife species.

Colusa National Wildlife Refuge

The Colusa NWR contains more than 4,500 acres of permanent ponds, seasonal wetlands, watergrass fields, and uplands. It also has a lush riparian slough. The wetlands produce waterfowl food, such as millet, watergrass, and invertebrate populations. The upland areas of the refuge provide habitat for geese, upland birds, and other wildlife species.

Sutter National Wildlife Refuge

Most of the Sutter NWR is located in the Sutter Bypass, north of its confluence with the Tisdale Weir. Water is used on the refuge to maintain more than 2,500 acres of ponds and seasonal wetlands. The wetlands support waterfowl food sources, such as swamp timothy, millet, and invertebrate populations. Approximately 500 acres of the refuge provide habitat for geese, upland birds, and other wildlife species.

Gray Lodge Wildlife Area

Gray Lodge WA is located adjacent to the Butte Sink, an overflow area of Butte Creek and the Sacramento River. It consists of 9,100 acres and supports ponds, wetlands, crops, and pasture. Wetland areas support waterfowl food sources, such as swamp timothy and invertebrate populations, and upland areas support habitat for geese, upland bird, and other wildlife species.

4.3.3.6.2 San Joaquin Valley Refuges

Several federal NWRs, State WAs, and private wetland areas occur in the San Joaquin River Basin. Included are three NWRs (San Luis NWR Complex, Kesterson NWR, and Merced NWR), four State WAs (Los Banos WA, Volta WA, Mendota WA, and North Grasslands WA), three units of the San Joaquin Basin Action Plan managed by USFWS (West Bear Creek Unit, East Bear Creek Unit, and

Freitas Unit), and private wetland areas in the Grassland RCD. The North Grasslands WA includes three units: Salt Slough, China Island, and Gadwall. Salt Slough and China Island are also part of the San Joaquin Basin Action Plan. Implementation of the action plan included acquiring several tracts of land—specifically, the West Bear Creek, East Bear Creek, Freitas, Salt Slough, and China Island units. The West Bear Creek, East Bear Creek, and Freitas units were acquired by the federal government and are being managed as part of the San Luis NWR Complex. The Salt Slough and China Island units were acquired by the State and are being managed collectively as part of the North Grasslands WA.

San Luis National Wildlife Refuge Complex

The San Luis NWR Complex encompasses more than 26,600 acres of wetlands, riparian forests, native grasslands, and vernal pools. The refuge is composed of six contiguous units: San Luis, East Bear Creek, West Bear Creek, Freitas, Blue Goose, and Kesterson. The San Joaquin River bisects the eastern portion of the refuge. The refuge is a major wintering ground and migratory stopover point for large concentrations of waterfowl, shorebirds, and other waterbirds. Extensive upland habitats are found on the refuge. Many of these habitats are characterized by saline or alkaline conditions that are accentuated by the low rainfall and arid conditions that characterize the San Joaquin Valley. These habitats support a rich botanical community of native bunchgrasses, native and exotic annual grasses, forbs, and native shrubs. The refuge is host to significant assemblages of birds, mammals, reptiles, amphibians, insects, and plants, some of which, such as the tiger salamander and San Joaquin kit fox, are endangered species. The refuge is also home to a thriving population of tule elk.

The following management objectives (Reclamation et al. 2001b, p. 2-2) have been identified for the San Luis NWR Complex:

- Provide feeding and resting habitat for wintering waterfowl
- Provide habitat and manage for endangered, threatened, and sensitive species of concern
- Protect and provide habitat for neotropical migratory landbirds
- Preserve a natural diversity and abundance of flora and fauna
- Provide for compatible, management-oriented research
- Alleviate crop depredation
- Provide public use activities, such as wildlife observation, photography, environmental education, and hunting
- Further the goals of the NWR system

Los Banos Wildlife Area

The Los Banos WA contains more than 6,000 acres in the San Joaquin River floodplain, approximately 4 miles northeast of Los Banos, and is dominated by seasonal wetlands. Permanent and semipermanent wetlands are also present, along with areas of riparian habitat. The Los Banos WA also supports natural and nonnative grasslands. Irrigated pasture and croplands are maintained to provide food, resting, and nesting habitat for waterfowl and other wildlife.

Volta Wildlife Area

The Volta WA consists of approximately 2,900 acres in the Grassland RCD. The WA supports permanent and seasonal wetlands and valley alkali shrub. Irrigated pasture and crops are grown to provide food and nesting cover for migratory waterfowl. Beaver, coyotes, cottontails, and 150 species of birds, including large numbers of waterfowl and shorebirds, are found on the WA (DFG 2011d).

North Grasslands Wildlife Area

The China Island Unit borders the San Joaquin River southwest of the confluence with the Merced River. The unit consists mainly of irrigated pasture and natural grasslands (Reclamation et al. 1995), but it also contains valley oak woodland/riparian habitat that provides important habitat for a variety of wildlife. The pastures provide habitat for geese, including the recently delisted Aleutian Canada goose, and sandhill cranes (Reclamation et al. 1995, p. 16). The Salt Slough Unit is located on the west side of Salt Slough, adjacent to the San Luis NWR Complex and Los Banos WA. Before its acquisition, the unit consisted mainly of irrigated pasture and was managed as a cattle ranch (Reclamation et al. 1995, p. 97). The pasture provides important late winter and early spring habitat for geese, including the recently delisted Aleutian Canada goose. Together, these two units provide more than 7,000 acres of wetlands, riparian habitat, and uplands. Restoration and enhancement actions have focused on increasing seasonal wetlands, permanent and semipermanent wetlands, and riparian habitat on the unit (Reclamation et al. 1995, pp. 65 and 66 and 97 and 98). The restored and created wetlands are now habitat for the Swainson's hawk and sandhill crane (DFG 2011e).

Mendota Wildlife Area

Mendota WA is located in western Fresno County, approximately 4 miles southeast of the town of Mendota, and contains more than 11,000 acres of flatlands and floodplain. Throughout its recent history, the Mendota WA has been managed primarily to provide seasonal wetland habitat. Water is used to irrigate natural food crops, such as swamp timothy, alkali bulrush, smartweed, and millet, and to flood seasonal and semipermanent wetlands. Small grains, corn, and pasture are also irrigated in the upland areas.

Grassland RCD

The Grassland RCD contains approximately 75,000 acres and is composed of private hunting clubs and other privately owned wetland areas, as well as all or portions of several federal and State refuges (such as Kesterson NWR, Volta WA, Los Banos WA, the Freitas Unit, the Salt Slough Unit, the Blue Goose Unit, the Gadwall Unit). The area is the largest continuous block of wetlands remaining in the Central Valley and is a major wintering ground for migratory waterfowl and shorebirds of the Pacific Flyway (Grassland Water District 2011).

Lands in the Grassland RCD are primarily managed for waterfowl habitat. The Grassland Water District has a water management plan that guides water use on nearly all lands in the Grassland RCD. In addition, the management objectives of the Grassland RCD include an active program to encourage production of natural food plants (such as swamp timothy, smartweed, and watergrass) and habitat protection. Land uses include seasonally flooded wetlands, moist soil impoundments, permanent wetland, irrigated pasture, and croplands.

4.3.3.6.3 Tulare Lake Basin Refuges

Kern National Wildlife Refuge

The Kern NWR contains more than 11,000 acres, approximately 5,000 to 6,500 acres of which consist of seasonal wetlands, irrigated moist soil units, and riparian habitat. In addition, uplands total approximately 3,600 acres and are made up of grassland, alkali playa, and valley sink scrub habitats. All wetlands are seasonal in nature. Fall flooding begins in mid-August and reaches a peak of nearly 6,500 acres of flooded marsh habitat by January. Habitat is maintained through February, after which a slow draining of the wetland begins. Selected units are irrigated during late spring and early summer to encourage plants to grow in order to provide food for wintering and migrating birds the following fall (USFWS 2011b). Uplands occupy the northeastern and northwestern portions of the refuge and have been set aside for threatened and endangered species, such as San Joaquin kit fox, Tipton kangaroo rat, and blunt-nosed leopard lizard.

Pixley National Wildlife Refuge

The Pixley NWR contains almost 7,000 acres. Approximately 5,300 acres are upland habitats consisting of grassland, alkali playa, and vernal pool habitat, and 750 acres are seasonal wetlands. All wetlands are seasonal in nature and are managed similar to the wetlands on the Kern NWR, described previously. Upland areas support a wide variety of plant communities, such as nonnative annual grass and alkali playas with vernal pools scattered throughout. Management of these areas primarily consists of cattle grazing from November through April to help provide optimum habitat for blunt-nosed leopard lizard, Tipton kangaroo rat, and San Joaquin kit fox (USFWS 2011c).

4.3.4 Areas Outside the Delta That Use Delta Water

Areas outside the Delta that receive water from the Delta amount to about 24,120,000 acres and cover approximately 23 percent of the land in the state. Unlike the Delta, this area does not encompass contiguous lands but instead is a combination of separate regions. The northern portion of this area comprises land in Alameda, Contra Costa, Napa, Sonoma, San Francisco, San Mateo, Santa Cruz, Santa Clara, and Monterey counties. The central portion of this area includes land in Fresno, Tulare, and Kings counties. The southern portion of this area includes land in every county in the state south of San Luis Obispo and Kern counties, with most of the population in Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Santa Barbara counties. For a discussion of land cover patterns in this area, see Section 6, Land Use and Planning. Figure 6-11 shows a map of the natural habitats in these areas.

Each of these areas contains habitat for fish, wildlife, and plant species, including special-status species, and sensitive habitats. In addition, portions of these areas are covered by adopted habitat conservation plan (HCP) and Natural Community Conservation Plan (NCCP). Because of the uncertainty associated with the location, size and implementation timing of potential effects resulting from the Delta Plan in these areas, the environmental setting for biological resources for the area was not described.

4.4 Impacts Analysis of Project and Alternatives

4.4.1 Assessment Methods

The Proposed Project (Delta Plan) and alternatives would not directly result in construction or operation of projects or facilities and therefore would result in no direct impacts on biological resources. The Proposed Project and alternatives could ultimately result in or encourage implementation of actions or development of projects, such as facilities or infrastructure, as described in Section 2A, Proposed Project and Alternatives. Examples of potential actions include conversion of agricultural lands for ecosystem restoration and land fallowing to accommodate water transfers. Projects may include water and wastewater treatment plants; conveyance facilities, including pumping plants; surface water or groundwater storage facilities; ecosystem restoration projects; flood control levees; or recreation facilities. Implementation of these types of actions and construction and operation of these types of facilities could result in direct, indirect, and cumulative impacts on biological resources.

The precise magnitude and extent of project-specific impacts on biological resources would depend on the type of action or project being evaluated, its specific location, its total size, and a variety of project- and site-specific factors that are undefined at the time of preparation of this program-level EIR. Project-specific biological resource impacts would be addressed in project-specific environmental documents prepared by the lead agency at the time the projects are proposed for approval.

This program-level document qualitatively assesses the potential impacts on biological resources resulting from implementation of the Proposed Project and alternatives in terms of how project components could affect fish and wildlife habitat, sensitive natural communities, special-status species, or conflict with local and regional policies, ordinances, and plans. Because project-level details of the specific location, type and extent of construction activities, including the footprint of the construction projects and whether they will be located in or near biological resources, are not yet available, potential types of impacts to biological resources were evaluated for construction in the Study Area.

Effects on natural communities and fish and wildlife habitats were assessed by anticipating how various actions resulting indirectly and ultimately from implementation of the Proposed Project and the alternatives could result in the loss or degradation of terrestrial or aquatic habitats for special-status species, including sensitive natural communities, and designated critical habitat. The assessment is not site-specific, but takes into consideration the current habitats in the Study Area, particularly in the Delta, and the potential of those habitats to be affected by various actions that could indirectly or ultimately result from implementing the Proposed Project or the alternatives.

Impacts on special-status species were assessed based on potential effects on their habitats. In addition, potential impacts of actions on special-status species (for example disturbance, increased predation, and physical injury) were qualitatively assessed. For actions in the Delta and Suisun Marsh, each of the alternatives also was assessed for its potential to conflict with existing regional and local policies, ordinances, and plans, including HCPs and NCCPs.

This EIR proposes mitigation measures for impacts on biological resources. The ability of these measures to reduce these impacts to less-than-significant levels depends on project-specific environmental studies; enforceability of these measures depends on whether or not the project being proposed is a covered action. This is discussed in more detail in Section 2B, Introduction to Resource Sections.

4.4.2 Thresholds of Significance

Based on Appendix G of the State CEQA Guidelines, an impact related to biological resources is considered significant if the Proposed Project would do any of the following:

- Have a substantial adverse effect on any sensitive natural community, including wetlands and riparian habitats identified in local or regional plans, policies, or regulations, or by USFWS or DFG, through alteration, direct removal, filling, hydrological interruption, or other means. Wetlands include marshes, vernal pools and coastal wetlands and other federally protected wetlands, as defined by section 404 of the CWA, and wetlands protected by the State under the Porter-Cologne Water Quality Control Act and the State no-net-loss of wetlands policy (California Executive Order W-59-93).
- Have a substantial adverse effect, either directly or through habitat modifications, on any species listed as endangered, threatened or rare, or designated as a candidate, proposed, sensitive or special-status species in local or regional plans, policies, or regulations or by DFG, USFWS, or NMFS.
- Substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife species to drop below self-sustaining levels; threaten to eliminate a plant or animal community; or substantially reduce the number or restrict the range of an endangered, threatened or rare species.
- Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites.

- Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance.
- Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or State habitat protection plan.

The definition of wetlands used in this document includes those natural communities (see Section 4.3.2.3, Natural and Agricultural Communities) that support wetland vegetation, i.e., a prevalence of vegetation typically adapted for life in saturated soil conditions. This definition includes federally protected wetlands, but in addition also includes natural communities that support wetland vegetation, but do not meet the hydrology and soils criteria used by the USACE to define federally protected wetlands (Environmental Laboratory 1987). That definition is consistent with the interpretation of wetlands as used by DFG, the California Coastal Commission, and Regional Water Quality Control Boards (RWQCB).

In addition to wetlands, sensitive natural communities also include other natural communities that are tracked by DFG in the CNDDB, such as inland dune scrub, oak woodlands, or riparian natural community types. Sensitive natural communities are also those plant or animal communities that potentially could be eliminated by human activities. Oak woodlands are considered sensitive communities because a number of studies have shown that oak regeneration has declined for Valley oak, the most common oak woodland species on the Central Valley floor, and because coast live oaks are under threat of “sudden oak death” disease (Tyler at al. 2006). Blue oak populations do not show a long term trend of decline (Tyler et al. 2006), but there is evidence that blue oak regeneration is reduced by competition with nonnative grasses (Gordon and Rice 1993, 2000; Gordon et al. 1989). The sensitive nature of oak woodlands is reflected in their protection under Public Resource Code 21083.4 which requires counties to determine whether projects “may result in a conversion of oak woodlands that will have a significant effect on the environment” (the law does not apply to oak woodlands dominated by black oak). When it is determined that such a project may have a significant effect, mitigation is required. The sensitive status of oak woodlands is also reflected in the Oak Woodlands Conservation Act of 2001 (Fish and Game Code 1360-1372), which directs the Wildlife Conservation Board to establish a program that shall issue grants to private land owners for the protection of oak woodlands on their property.

The introduction and substantial spread of nonnative invasive species or noxious weeds, while not specifically mentioned in Appendix G of the CEQA Guidelines, also could adversely affect special-status species or sensitive natural communities that are regulated by State and federal regulations and are therefore analyzed in this section.

The following discussion of environmental impacts is limited to those potential impacts that could result in some level of significant environmental change, as defined by CEQA. As individual projects are proposed, these individual projects will need to be evaluated in site-specific environmental documents prepared by the lead agencies.

4.4.3 Proposed Project

4.4.3.1 Reliable Water Supply

As described in Sections 2A and 2B, the Delta Plan does not direct the construction of specific projects, nor would projects be implemented under the direct authority of the Delta Stewardship Council. However, the Delta Plan seeks to improve water supply reliability by encouraging various actions that, if taken,

could lead to completion, construction, and/or operation of projects that could provide a more reliable water supply. Such projects and their features could include the following:

- Surface water projects (water intakes, treatment and conveyance facilities, reservoirs, hydroelectric facilities)

- Groundwater projects (wells, wellhead treatment, conveyance facilities)
- Ocean desalination projects (water intakes, brine outfalls, treatment and conveyance facilities)
- Recycled wastewater and stormwater projects (treatment and conveyance facilities)
- Water transfers
- Water use efficiency and conservation program implementation

The number and location of all potential projects that would be implemented are not known at this time. However, the Proposed Project specifically names the DWR Surface Water Storage Investigation, which includes the North-of-the-Delta Offstream Storage Investigation (aka Sites Reservoir), Los Vaqueros Reservoir Project (Phase 2), and the Upper San Joaquin River Basin Storage Investigation Plan (aka Temperance Flat Reservoir), and DWR Bulletin 118.

4.4.3.1.1 Impact 4-1a: Substantial Adverse Effects on Sensitive Natural Communities, Including Wetlands and Riparian Habitat

Construction of facilities associated with surface water and groundwater projects (including those that could be encouraged through the update of Bulletin 118), ocean desalination projects, and recycled wastewater and stormwater projects could result in ground disturbance of varying extents and disturbance of waterways adjacent to the construction sites. These facilities could be constructed in the Delta, in the Delta watershed, or in areas outside the Delta that use Delta water, as described in Section 2A, Proposed Project and Alternatives. Construction-related ground and surface water disturbance could result in temporary damage to or the permanent removal of sensitive natural communities located in and adjacent to the construction site. The actual effects on sensitive natural communities would depend on the size of the facility footprint and its location relative to sensitive community occurrences. Affected sensitive natural communities could include non-tidal emergent wetlands, vernal pools, alkali seasonal wetlands, riparian forest and scrub, oak woodlands, and other sensitive communities. Once constructed, operation of these facilities would not likely continue to adversely affect sensitive natural communities.

The Davis-Woodland Water Supply Project EIR (City of Davis et al. 2007) was reviewed to assess the types of effects that could result from installing a new water intake and constructing pumping plants and conveyance and water treatment facilities. This project is analogous to the types of water projects described above. In this EIR, the City found that the project would adversely affect sensitive habitats, specifically riparian habitat and wetlands, during construction. However, these impacts were determined to be less than significant after application of mitigation, such as the use of trenchless construction techniques to avoid riparian vegetation. In addition, the City indicated that the operation of new groundwater wells had the potential to adversely affect wetlands and other sensitive habitats by disrupting the groundwater hydrology that supports those communities. This impact was found to be less than significant by applying mitigation that restricted the development and use of wells in areas that could influence sensitive communities. The EIR for the Carlsbad Precise Development Plan and Desalination Plant Project (City of Carlsbad 2005), which illustrates some the likely impacts of ocean desalination plants, also was reviewed. For this project, the lead agency found that impacts to several sensitive vegetation communities and wetlands would be significant, but that they could be mitigated to less-than-significant levels by incorporation of specific mitigation measures.

In addition to the types of potential impacts described above for water supply projects, the large surface storage reservoirs encouraged by the Proposed Project could result in the inundation of thousands of acres of habitat used by wildlife and the loss of sensitive natural communities. The impacts of these types of projects would depend on the ultimate location of the reservoirs and their proximity to sensitive natural communities. These projects would occur mostly outside of the Delta.

Of the three large surface storage reservoirs considered by the DWR Surface Water Storage Investigation, only the Los Vaqueros Reservoir Expansion Project has undergone project-specific environmental review via an EIS/EIR; the other two projects have not. The Los Vaqueros EIS/EIR provides specific information on the impacts of that project; however, it also provides analogous information about the types of impacts expected from construction and operation of these two other projects, which are similar. In addition, the project-specific EIR for another surface storage project (not named in the Delta Plan) – the Calaveras Dam Replacement Project – also provides analogous information.

The Los Vaqueros Reservoir Expansion EIS/EIR (Reclamation et al. 2009) evaluated several alternatives to increase water storage, some of which included a new Delta intake structure, and conveyance facilities. The lead agency found that construction of the project would adversely affect sensitive natural communities, including jurisdictional wetlands and waters, but that these impacts would be less than significant after mitigation. The San Francisco Public Utilities Commission (SFPUC) found in its final EIR for the Calaveras Dam Replacement Project that the project would result in significant impacts to wetlands and other aquatic habitats that also could be mitigated to less-than-significant levels (SFPUC 2011).

Construction activities associated with any of these water supply reliability facilities could lead to the introduction or spread of invasive species or noxious weeds in sensitive communities, including wetlands. Construction equipment could transport or other propagules of these species, and construction–related ground surface disturbance could provide opportunities for establishment of these species. Invasive species or noxious weeds could degrade the habitat quality of sensitive communities, including wetlands, by competition with and suppression of native species. The operation of these facilities could also support the establishment and spread of invasive species if the facilities (e.g., reservoirs) create suitable conditions for those species.

Actions to enhance water supply reliability also could include water transfers and modified reservoir operations. Water transferred from north of the Delta could result in a temporary increase in water in the rivers flowing into the Delta, which could provide benefits to adjacent wetlands and riparian communities. Changes in flow in rivers that are tributary to the Delta might also influence the hydrodynamics, scour, and salinity gradients in the Delta. These changes could reduce the extent of brackish or freshwater marsh in the Delta. Changes in water operations in the CVP and SWP and other water systems also could alter the timing and magnitude of water fluctuations in the upstream reservoirs and adversely influence wetlands and riparian communities along the edges of the reservoirs. Other programs intended to improve water supply reliability, such as water conservation, could result in more water remaining in the rivers tributary to the Delta and less water removed from the Delta. This could potentially benefit wetlands and riparian communities along the rivers and Delta channels.

The Lower Yuba River Accord EIR (DWR et al. 2007) was reviewed as an example of a project that assessed the effects of water management, including water transfers. In this document, the lead agency found that changes in flows and reservoir surface elevations that could degrade riparian vegetation and continuous strands of native vegetation of relatively high or moderate value to wildlife would result in less than significant impacts.

The review of environmental analyses of similar projects suggests that the impacts of these types of projects would be less than significant or less than significant with mitigation, especially for water supply facilities with small footprints. However, projects encouraged by the Proposed Project could include new surface storage, which has the potential to permanently remove (inundate) large tracts of land and substantially affect sensitive natural communities, if present. For all encouraged projects and actions the impacts on sensitive communities would result primarily from construction of the facilities. Once completed, the impacts of operation would be minimal.

Future project-specific analyses may develop adequate information to arrive at a different conclusion; however, for purposes of this program-level analysis, this potential impact is considered **significant**.

4.4.3.1.2 Impact 4-2a: Substantial Adverse Effects on Special-status Species

Projects to improve water supply reliability, such as the North Bay Aqueduct Alternative Intake project identified in the Delta Plan (Proposed Project), could include water intakes, pumping plants, sedimentation basins, treatment, and associated conveyance facilities (e.g., pipelines and canals). These types of projects could be constructed in the Delta, Delta watershed, and in areas outside the Delta that receive Delta water. Construction-related activities associated with these project types could harm or kill special-status species. Noise and night-time lighting from construction equipment could disturb special-status birds and mammals, and construction dust could affect species such as valley elderberry longhorn beetle. Special-status amphibians, reptiles, small mammals, and plants could be killed by construction and earthmoving equipment. This disturbance and direct mortality, should it occur, would constitute “take” under ESA, CESA, and/or the NPPA if it affects animal or plant species that are listed as threatened or endangered, candidates for listing, or plant species that are listed as rare. Operation of these facilities, with the possible exception of water intakes, would be less likely to adversely affect special-status species.

Special-status fish species, including delta smelt, Chinook salmon, steelhead, green sturgeon, Sacramento splittail, longfin smelt, and others in the Delta and the Delta tributaries also might be adversely affected by construction of facilities in or near the water, such as water intakes and pumping plants, by the release of sediment into the water column, dewatering of construction areas, or through acoustic effects associated with pile-driving or placement of sheet pile barriers. Construction or modification of these types of facilities also could result in the loss of habitat for special-status aquatic species at the locations where the facilities are constructed. These localized impacts at the facilities could include the physical removal or covering of channel bottom substrates, removal of aquatic and riparian vegetation, and removal of access to aquatic habitats. Operation of intake facilities might result in the entrainment of special status fish species, create conditions that promote predation, and increase the possibility of the release of toxic materials into the adjacent water body.

The Davis-Woodland Water Supply Project EIR (City of Davis et al. 2007) was reviewed to assess the types of effects that could result from installing new water intakes and constructing pumping plants and conveyance and water treatment facilities. This project is analogous to the types of water projects described above. In this EIR, the City found that the project would have substantial adverse effects on special-status species similar to those described above. Specifically, the City found that the construction of the project could adversely affect special-status fish, wildlife, and plant species. However, these impacts were determined to less than significant after the application of mitigation that included measures such as conducting clearance surveys prior to construction, placement of buffer zones around known nest sites, and replacement of habitat permanently lost by construction. In addition, potential impacts on special-status fish resulting from noise or vibration and entrainment at the intake were evaluated, but found to be less than significant.

The Supplemental EIR /EIS for the Riverside-Corona Feeder Project (Western Municipal Water District and Reclamation 2011), which includes a large capacity, 28-mile-long water pipeline, also was reviewed as an example of the types of impacts that could occur as a result of the Proposed Project. For this project, the lead agencies found that construction of the pipeline could result in significant impacts on special-status species, but that the impacts could be reduced to a less-than-significant level with mitigation.

Small storage reservoirs, regulating reservoirs, and groundwater percolation basins that might be constructed to improve water supply reliability throughout the Study Area could affect special-status species within the footprints of those facilities through disturbance, habitat loss, or direct injury. The extent of impact would be influenced by the size of the facility footprint and its location relative to populations of special-status species.

Construction of large surface water storage reservoirs such as those considered in DWR's Surface Water Storage Investigation (Sites, Los Vaqueros, and Temperance Flat reservoirs) would largely occur outside the Delta. Disturbance and habitat loss associated with facilities construction might adversely affect terrestrial and aquatic special-status species if those species inhabit the affected areas. Inundation of new large storage reservoirs would have the potential to result in the loss of thousands of acres of habitat for terrestrial wildlife and plants and impact special-status species. Aquatic species also could be adversely impacted by inundation of existing aquatic habitats and disruption of the surface hydrology of the area. These surface water storage projects might also have associated conveyance networks and hydroelectric facilities that could result in habitat loss or direct impacts on special-status species. Operation of these large storage facilities, or water supply reliability actions that modify operations of the CVP, SWP, or other water systems, might affect special-status species depending on the extent to which the operation influences the flows in connecting rivers or streams. Changes in surface water storage operations could influence the timing and magnitude of flows and water temperature in downstream water bodies used by special-status species. Changes in flow in rivers that are tributary to the Delta might also influence the flow, currents, and temperature and salinity gradients in the Delta. These changes could reduce the quality and suitability of aquatic habitats for special-status fish species such as delta smelt.

The Los Vaqueros Reservoir Expansion Project Draft EIS/EIR (Reclamation et al. 2009) and Calaveras Dam Replacement Project Final EIR (SFPUC 2011) are illustrative of some of the types of biological impacts associated with surface water storage projects. The EIS/EIR for the Los Vaqueros Reservoir Expansion evaluated several alternatives to increase water storage, some of which included a new Delta intake structure, and conveyance facilities. The lead agency found that project construction would adversely affect a number of special-status species, but that these impacts could be mitigated to less than significant levels. For example, the lead agency found that underwater sound-pressure levels generated during cofferdam installation for the new intake could result in behavioral avoidance or migration delays for special-status fish species. With mitigation, such as scheduling construction during periods when fish were not present and the use of an air bubble curtain to deflect and absorb sound pressure, this impact was determined to be less than significant. The San Francisco Public Utilities Commission in its final EIR for the Calaveras Dam Replacement Project also found that the project would result in significant impacts to a variety of special-status species, and that these impacts could be mitigated to less-than-significant levels (SFPUC 2011).

Ocean desalination plants might be constructed and operated outside the Delta to increase water supply. The construction of these facilities would have impacts similar to those described above for construction of water intakes, pumping plants, and associated conveyance facilities. However, operation of desalination facilities along the coast would entrain marine organisms into the intake facilities and discharge brine waste into the ocean, which could adversely affect marine life at and near the discharge outlet. The EIR for the Carlsbad Precise Development Plan and Desalination Plant Project (City of Carlsbad 2005), which illustrates some the likely impacts of ocean desalination plants, found that the impacts to one special-status species affected by habitat loss resulting from facility construction could be mitigated to less than significant levels by incorporation of identified mitigation measures.

Actions to enhance water supply reliability could include water transfers and modified water operations that could affect special-status species. Changes in surface water storage operations could influence the timing and magnitude of flows and water temperature in downstream water bodies used by special-status species. Water transferred from north of the Delta could result in a temporary increase in water in the

rivers flowing into the Delta, which might provide benefits to aquatic species. However, temporary or permanent fallowing of agricultural land to facilitate the transfers might lead to a reduction in habitat for special-status species that use agricultural lands, such as giant garter snake. The Lower Yuba River Accord EIR (DWR et al. 2007) was reviewed to assess the types of effects of water management, including water transfers. The lead agency for this project found that changes in flows, temperatures and reservoir surface elevations that could affect special-status fish species would result in less-than-significant impacts and that no mitigation would be required.

Other programs intended to improve water supply reliability, such as water conservation, could result in more water remaining in the rivers tributary to the Delta and less water removed from the Delta. This could potentially benefit special-status species inhabiting the Delta and its tributaries.

All facilities constructed and operated in or upstream of the Delta have the potential to introduce invasive species through various means such as transport on construction equipment or vegetation plantings or support habitat for invasive species. Invasive species could prey upon, compete with, or displace special-status species or reduce the suitability of their habitats.

The impacts on special status species would result primarily from construction activities. Once constructed, the impacts of operation would be minimal. However, certain activities, such as water transfers that result in fallowing of agricultural land, could continue to produce impacts on special-status species that use agricultural land as habitat over the long term. Similarly, operation of water intakes on water bodies that support special-status aquatic species could have long-term effects.

While future project-specific analyses may develop adequate information to arrive at a different conclusion, for the purposes of this program-level analysis, this potential impact is considered **significant**.

4.4.3.1.3 Impact 4-3a: Substantial Adverse Effects on Fish or Wildlife Species Habitat

Construction and operation of facilities and other actions to improve water supply reliability have the potential to adversely affect habitat for fish and wildlife. The types of impacts and their mechanisms would be similar to those described above for sensitive habitats.

Project-level impacts on fish and wildlife habitat would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies. However, because named projects and projects encouraged by the Delta Plan could result in substantial adverse effects on habitats for fish and wildlife species, this potential impact is considered **significant**.

4.4.3.1.4 Impact 4-4a: Interfere Substantially with the Movement of Any Native Resident or Migratory Fish or Wildlife Species or with Established Native Resident or Migratory Wildlife Corridors

Construction and operation of facilities, such as water intakes and pumping plants, located along waterways could substantially interrupt migratory wildlife habitat corridors, particularly in riparian zones, and wetland features crossed by migratory bird and mammal species. Depending on the types of facilities constructed and their operational criteria, operations could block or delay migration or movement of migratory fish species that move to and from the Delta and its tributaries or undertake seasonal migrations within the Delta. Alteration of flow patterns and water quality in the Delta or its tributaries could also disrupt migratory cues for these species. These types of activities also could impact fish and wildlife migration in areas outside the Delta.

Construction and operation of large surface water storage reservoirs such as those considered in DWR's Surface Water Storage Investigation outside the Delta have the potential to interfere with the movement of native resident and migratory fish and wildlife species. Depending on the ultimate location of these reservoirs, the inundated areas, conveyance networks, and potential hydropower transmission systems

could interfere with established migration corridors for wildlife such as deer. Operations could also result in changes in flows or water temperatures that could impede or delay the migration or movement of special-status fish species in the waterways influenced by reservoir operations. Projects that include above ground conveyance facilities (e.g., canals) could block or disrupt the local and migratory movement of wildlife. As an example, the lead agency for the EIS/EIR completed for the Los Vaqueros Reservoir Expansion found that new power lines associated with the facility could adversely affect migratory birds, but that these impacts could be mitigated to less than significant levels. Another example, the final EIR for the San Francisco Public Utilities Commission's Calaveras Dam Replacement Project, found that the project could affect fish movement/migration, specifically project the creation of barriers to fish movement/migration upstream in Calaveras and Alameda creeks, but that effect of barriers would not represent an impact (SFPUC 2011).

In addition to the reservoir projects, facilities that include intakes and conveyance also could affect fish and wildlife movement. For example, the EIR for the Davis-Woodland Water Supply Project (City of Davis et al. 2007) found that construction could temporarily affect giant garter snake movement, although this impact was determined to be less than significant with mitigation. The lead agency also concluded that operations of the project, including groundwater wells and minor levels of noise from pumps, would not lead to on-going disturbance or interference with the movement of any native wildlife species or wildlife corridors and nursery sites, and that temporary increases in river flows resulting from the project would not adversely affect movement of wildlife species or interfere with wildlife corridors or the use of wildlife nursery sites.

Facilities constructed to improve water supply reliability could temporarily interfere with the movement of fish and wildlife during construction. These projects could continue to interfere with the movement of fish and wildlife during operations, particularly those that could influence large areas or alter flows such as new surface water storage projects. While the review of environmental analyses of similar projects suggests that the impacts of these types of projects would be less than significant or could be mitigated to a level that is less than significant, there remains sufficient uncertainty about the specifics of future projects to draw the same conclusion. Therefore, for the purposes of this program-level analysis, this potential impact is considered **significant**.

4.4.3.1.5 Impact 4-5a: Conflict with Any Local Policies or Ordinances Protecting Biological Resources or the Provisions of an Adopted Habitat Conservation Plan, Natural Community Conservation Plan, or Other Approved Local, Regional, or State Habitat Protection Plan

Many water supply reliability actions encouraged by the Proposed Project would be implemented in areas covered by local policies or ordinances protecting biological resources or the provisions of an adopted HCP or NCCP. This applies to all areas of the state where these projects might be implemented. In areas within the Delta and Suisun Marsh, there are many local policies and ordinances that protect biological resources. Several city and county jurisdictions have general plan policies, zoning ordinances, and other requirements that address the management of specific biological resources. The general plan policies that address biological resources in the Delta are presented in Appendix F-2 (also see Appendix D, Regulatory Framework). Actions encouraged by the Proposed Project have the potential to conflict with these general plan policies.

Actions encouraged by the Proposed Project within the plan area boundaries of existing conservation plans (i.e., HCPs and NCCPs) in the Delta could occur within the boundaries of San Joaquin County Multi-Species Habitat Conservation and Open Space Plan and the East Contra Costa County HCP/NCCP, both of which extend into the Delta. Most water reliability actions and projects encouraged by the Proposed Project, such as water supply projects carried out by local agencies, would likely be considered "covered activities" of those adopted HCP or NCCP plans, and therefore consistent. Actions carried out in areas outside the plan areas of those plans would not likely result in a conflict unless the influence of the

action extended within the conservation plan boundaries. In all cases, the Proposed Project would not affect the provisions of those adopted plans or the long-term assurances received by the permitted entities regarding incidental take.

Project-level impacts would be addressed by future site-specific environmental analyses conducted at the time such projects are proposed by lead agencies. Although named projects and projects encouraged by the Proposed Project would not likely conflict with adopted HCPs and NCCPs in the Delta, they could conflict with HCPs and NCCPs in other areas of the Study Area as well as with local policies or ordinances. Therefore, this potential impact is considered **significant**.

4.4.3.2 Delta Ecosystem Restoration

As described in Sections 2A and 2B, the Delta Plan does not direct the construction of specific projects, nor would projects be implemented under the direct authority of the Delta Stewardship Council. However, the Delta Plan seeks to improve the Delta ecosystem by encouraging various actions and projects that, if taken, could lead to completion, construction, and/or operation of projects that could improve the Delta ecosystem.

Features of such projects and actions that could be implemented as part of efforts to restore the Delta ecosystem include the following:

- Floodplain restoration
- Riparian restoration
- Tidal marsh restoration
- Ecosystem stressor management (e.g., continuation of ongoing programs managing pesticide runoff, water quality, water flows)
- Invasive species management (including removal of invasive vegetation)

The number and location of all potential projects that could be implemented are not known at this time. Nine projects or project locations, however, are known to various degrees and are named in the Delta Plan:

- Cache Slough Complex (includes Prospect Island Restoration Project)
- Cosumnes River-Mokelumne River Confluence: North Delta Flood Control and Ecosystem Restoration Project
- Lower San Joaquin River Bypass Proposal
- Suisun Marsh Habitat Management, Preservation, and Restoration Plan (includes Hill Slough Restoration Project)
- Yolo Bypass
- Water Quality Control Plan Update for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary
- Delta Conservancy Strategic Plan
- Variance for USACE Vegetation Policy
- DFG’s Stage Two Actions for Nonnative Invasive Species

Of the five restoration areas identified in the Proposed Project, two have projects that have undergone project-specific environmental review: the North Delta Flood Control and Ecosystem Restoration Project (DWR 2010) and the Suisun Marsh Habitat Management, Preservation, and Restoration Plan (Reclamation et al. 2010).

The Proposed Project encourages the State Water Resources Control Board (SWRCB) to update the Water Quality Control Plan Update for the San Francisco Bay/ Sacramento-San Joaquin Delta Estuary and develop, implement, and enforce updated flow requirements for the Delta and high-priority tributaries in the Delta watershed that are necessary to achieve the coequal goals. As described in Section 2A, Proposed Project and Alternatives, these actions would likely result in a more natural flow regime in the Delta and Delta tributaries, and reduced export of water from the Delta. Water users in the areas outside the Delta that use Delta water would likely respond to reduced supplies by constructing facilities to improve water supply reliability and improve water quality. The impacts on biological resources associated with these actions to improve water supply reliability and water quality would be the same as those described above in Section 4.4.3.1.1 (reliable water supply) and Section 4.4.3.3.1 (water quality improvement) below.

The Delta Conservancy Strategic Plan is anticipated to provide a framework that would facilitate ecosystem restoration in the Delta. The general impacts associated with the ecosystem restoration that could result from that planning process are described below.

The impacts associated with obtaining a variance to the USACE Vegetation Policy are described under in Section 4.4.3.4.1 (flood risk reduction), below.

DFG's Stage Two Actions for Nonnative Invasive Species (DFG 2011a) identifies six actions for preventing the establishment of additional nonnative invasive species and reduce their economic and ecological impacts. These actions focus on monitoring, study, and coordination. The encouragement of the continuation of these actions would not physically change existing conditions; therefore, this study program is not discussed further in this section.

4.4.3.2.1 Impact 4-1b: Substantial Adverse Effects on Sensitive Natural Communities, Including Wetlands and Riparian Habitat

The Delta Plan encourages implementation of ecosystem restoration in the following areas of the Delta: the Cache Slough Complex, Cosumnes River-Mokelumne River Confluence, lower San Joaquin River, Suisun Marsh, and Yolo Bypass. However, it is not clear what specific restoration projects would be constructed in these areas, or at what specific locations. Sensitive natural communities could be removed as a result of construction activities associated with ecosystem restoration, including the construction of levees and berms, as well as temporary removal of riparian vegetation and scrub, and wetlands.

These restoration projects generally would restore many more acres of riparian habitat and wetlands than would be temporarily removed. In the case of riparian forest in particular, it may take up to a decade before planted habitat values replace the value of temporarily removed riparian forest habitat. Wetlands could also be adversely affected during construction, but generally increased as a result of the restoration actions. For example, the Suisun Marsh Habitat Management, Preservation, and Restoration Plan EIS/EIR (Reclamation et al. 2010), which addressed ecosystem restoration in the Suisun Marsh, found that the effects on wetlands associated with the project would be less than significant or beneficial.

Ecosystem restoration actions that connect and reactivate floodplains in areas such as the Yolo Bypass, Cosumnes-Mokelumne River confluence, and lower reaches of the San Joaquin River also could result in temporary adverse affects on sensitive natural communities. Some sensitive natural communities, for example vernal pools and alkali seasonal wetlands, could be lost as a result of construction activities, such as earth moving.

The final EIR for the North Delta Flood Control and Ecosystem Restoration Project (DWR 2010), a named project in the proposed Delta Plan, analyzed proposed flood management and ecosystem restoration projects in the north Delta, specifically around the Cosumnes-Mokelumne River confluence. The lead agency found that there would be the potential for significant impacts on riparian natural communities, tidal and nontidal wetlands, and perennial grassland during construction due to direct losses and disturbance. These impacts were considered significant. However, these impacts were determined to be less than significant with mitigation by avoiding construction in these community types or replacing lost habitat. Restoration actions that increased the availability and quality of sensitive natural communities were considered beneficial.

In addition to the encouragement of habitat restoration actions, the Proposed Project encourages the SWRCB to update the Water Quality Control Plan, including development of flow criteria for priority tributaries and new flow objectives for the Delta. The updated flow objectives would result in less-than-significant or beneficial effects on riparian and wetland communities along priority tributaries and in the Delta, if the new flow requirements reflect a more natural flow regime. The implementation of these flows, however, could result in a reduction in the availability of water for export from the Delta. This could lead to a significant impact on sensitive communities if this reduction were to lead to dewatering of agricultural conveyance channels that support riparian vegetation.

Ecosystem restoration also has the potential to introduce or create conditions that support nonnative invasive species through introduction of propagules on construction equipment and by inadvertently creating site conditions that allow invasive species to become established. Invasive species established in restoration areas have the potential to adversely affect sensitive natural communities as indicated above in Section 4.4.3.1.1. Establishment of invasive nonnative plants was considered a significant impact in the North Delta Flood Control and Ecosystem Restoration Project EIR (DWR 2010). However, this effect could be reduced to less than significant by implementing mitigation measures.

Impacts to sensitive communities resulting from ecosystem restoration projects and actions would occur primarily from construction activities associated with the development and establishment of habitat. These impacts would generally be temporary in nature, and the long-term outcome of these actions would likely be beneficial.

Review of environmental analyses of similar projects suggests that these potentially significant impacts would be less than significant or mitigated to a less-than-significant level. However, because named projects and projects encouraged by the Proposed Project could result in adverse effects on sensitive natural communities, this potential impact is considered **significant**.

4.4.3.2.2 Impact 4-2b: Substantial Adverse Effects on Special-status Species

Ecosystem restoration actions encouraged by the Proposed Project would be focused in and adjacent to the Delta. Actions could include restoration or creation of habitats (e.g., tidal marsh) in areas such as Cache Slough and Suisun Marsh. Special-status species could be affected by the construction of berms and levees as well as temporary changes in local water circulation and turbidity. The conversion of pasture and agricultural land to accommodate restoration could result in temporary impacts on special-status species exposed to the construction. The resulting increase in tidal and subtidal habitats would benefit special-status species associated with these types of habitats. For example, the Suisun Marsh Habitat Management, Preservation, and Restoration Plan EIS/EIR (Reclamation et al. 2010), which assessed ecosystem restoration in Suisun Marsh, found that the impacts on special-status species would be less than significant or beneficial. While impacts to special status species resulting from Delta restoration actions would likely be minimal, the conversion of land (e.g., agricultural land) might adversely affect special-status species associated with those land types. For example, habitat could be reduced for Swainson’s hawks that are associated with agricultural lands in the Delta.

Ecosystem restoration actions that connect and reactivate floodplains in areas such as the Yolo Bypass, Cosumnes-Mokelumne River confluence, and reaches of the San Joaquin River located upstream and downstream of the lower San Joaquin River floodplain also could adversely affect special-status species, particularly where construction occurs in areas near the land-water interface. Construction activities in these areas, such as earth moving, have the potential to remove habitat and directly disturb terrestrial and aquatic special-status species inhabiting the area. Following construction, these actions could result in an increase in habitat for a variety aquatic special-status species, including Sacramento splittail and rearing juvenile Chinook salmon. Certain terrestrial species also could benefit. In areas that are farmed, restoration of the floodplain could change the timing and duration of inundation such that fewer acres of agricultural land could be farmed or cropping patterns could be changed. This could lead to a reduction of habitat for certain special-status species associated with agriculture.

The EIR for the North Delta Flood Control and Ecosystem Restoration Project (DWR 2010) analyzed the proposed flood management and ecosystem restoration projects in the north Delta, specifically around the Cosumnes-Mokelumne River confluence. The lead agency found that potential impacts to special-status fish, wildlife, and plant species during construction caused by direct losses and disturbance would be significant. They also found that the impacts of operation could significantly impact special-status fish species. However, in all cases, the impacts were determined to be less than significant with mitigation. In addition, the restoration actions were determined to result in increased availability and quality of habitat for special-status fish species, a beneficial impact.

The Proposed Project encourages the SWRCB to develop, implement, and enforce updated flow requirements for the Delta and high-priority tributaries in the Delta watershed that are necessary to achieve coequal goals. These flow requirements would take into consideration the flow needs of special-status fish species as well as riparian vegetation. These flow modifications would represent a beneficial change for special-status fish, and special-status wildlife and plants associated riparian communities. However, a change in flows in the Delta that reflect a more natural flow regime could result in a reduction in the availability of water for export from the Delta. If this reduction were to result in an increase in fallowing of farmland or land retirement in areas outside the Delta that use Delta water, habitat for special-status species that inhabit agricultural lands could be reduced.

Habitat restoration and other actions to create additional habitat have the potential to adversely affect special-status species primarily during construction activities. These impacts could be significant, but temporary. Operation of restored areas would likely benefit special-status species over the long term, as would changes in flow and water quality requirements encouraged by the Proposed Project. However, actions to restore wetland and other habitats could result in the permanent conversion of agricultural land that provides habitat for special-status species. Therefore, this potential impact is considered **significant**.

4.4.3.2.3 Impact 4-3b: Substantial Adverse Effects on Fish or Wildlife Species Habitat

Encouraging the construction and creation of large Delta ecosystem restoration projects has the potential to substantially reduce habitat for common (i.e., not special-status) fish or wildlife species. The large scale (thousands of acres) of these types of projects has the potential to convert substantial acreages of wildlife habitat (e.g., grasslands or agricultural lands that provide habitat to terrestrial species), to tidal and subtidal habitats. The mechanisms and types of potential impacts on fish or wildlife habitat would be similar to those described above for substantial adverse effects on sensitive natural communities and special-status species habitat in Sections 4.4.3.2.1 and 4.4.3.2.2.

Individually, ecosystem restoration projects would likely result in less-than-significant impacts on fish and wildlife habitat. For example, the Suisun Marsh Habitat Management, Preservation, and Restoration Plan EIS/EIR (Reclamation et al. 2010) found the impacts on fish and wildlife habitat to be less than significant or beneficial. The North Delta Flood Control and Ecosystem Restoration Project EIR (DWR 2010) identified significant impacts resulting from construction and/or operations on a number of

fish and wildlife habitats, including shaded riverine aquatic cover for fish species, wetland-, riparian-, and agricultural land and ruderal-associated wildlife habitat. It concluded that all of these impacts could be reduced to less than significant by implementing appropriate mitigation measures.

Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies. However, because named projects and projects encouraged by the Proposed Project could result in substantial adverse effects on fish and wildlife species habitat over the long term, this potential impact is considered **significant**.

4.4.3.2.4 Impact 4-4b: Interfere Substantially with the Movement of Any Native Resident or Migratory Fish or Wildlife Species or with Established Native Resident or Migratory Wildlife Corridors

In general, ecosystem restoration in and adjacent to the Delta encouraged by the Proposed Project should not interfere substantially with the movement of fish and wildlife. The creation or restoration of wetland (including tidal marsh) and active floodplain should provide greater opportunity for local movement by fish and wildlife species by increasing the size and connectivity of habitat in the Delta. These benefits would also accrue to migratory species, such as waterbirds, that depend on the availability of wetlands for wintering.

Construction or reconnection of tidal marsh and floodplains could produce temporary changes in local flow patterns, increases in turbidity, and an increased potential for the release of toxic materials. These changes could temporarily disrupt movement or migration of aquatic species. With mitigation, it is unlikely that these changes would substantially interfere with the movement of any native resident or migratory fish or wildlife species, or established wildlife corridors.

The impacts of updated flow requirements for the Delta and high-priority tributaries in the Delta watershed would be the same as described for changes in flows and temperatures due to changes in reservoir operations described in Sections 4.4.3.2.1 and 4.4.3.2.2, above.

While future project-specific analyses may develop adequate information to arrive at a different conclusion, for the purposes of this program-level analysis, this impact is considered **significant**.

4.4.3.2.5 Impact 4-5b: Conflict with Any Local Policies or Ordinances Protecting Biological Resources or the Provisions of an Adopted Habitat Conservation Plan, Natural Community Conservation Plan, or Other Approved Local, Regional, or State Habitat Protection Plan

The Proposed Project encourages ecosystem restoration in five identified priority areas: Cache Slough, Cosumnes-Mokelumne rivers confluence, lower San Joaquin River, Suisun Marsh, and Yolo Bypass. In addition, the Proposed Project would require that ecosystem restoration covered actions be consistent with the habitat types shown on the elevation map (Figure 5-2) of the Conservation Strategy for Restoration of the Sacramento-San Joaquin Delta Ecological Management Zone and the Sacramento and San Joaquin Valley Regions (DFG 2011a). Actions to restore habitat in these five areas would not occur within the incorporated cities and their spheres of influence and, therefore, would not conflict with local policies and ordinances that protect biological resources.

The Proposed Project includes policies that guide the types of ecosystem restoration (by elevation) that should occur in the Delta and Suisun Marsh, and the preservation of restoration opportunities. These policies are based on the Ecosystem Restoration Program (ERP) Conservation Strategy for Restoration of the Sacramento-San Joaquin Delta Ecological Management Zone and the Sacramento and San Joaquin Valley Regions (DFG 2011a). Ecosystem restoration actions guided by this conservation strategy could occur within areas covered by the adopted San Joaquin County Multi-Species Habitat Conservation and Open Space Plan and the East Contra Costa County HCP/NCCP. Ecosystem restoration consistent with

the Conservation Strategy for Restoration of the Sacramento-San Joaquin Delta Ecological Management Zone and the Sacramento and San Joaquin Valley Regions (DFG 2011a), would not likely conflict with these conservation plans, although a possible increase in demand for lands suitable for these actions could restrict the availability of land for mitigation actions by conservation plan permit holders.

Actions in areas outside the Delta that receive Delta water in response to updated flow objectives could be conducted in areas subject to local policies and ordinances as well as within the boundaries of adopted HCPs or NCCPs. The potential for those actions to conflict with those policies, recommendations, and plans would be the same as described in Section 4.4.3.1.5 (reliable water supply).

Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies. Although named projects and projects encouraged by the Proposed Project are not likely to conflict with adopted HCPs, NCCPs, or other conservation plans, they could conflict with local policies or ordinances. Therefore, this potential impact is considered **significant**.

4.4.3.3 Water Quality Improvement

As described in Sections 2A and 2B, the Delta Plan does not direct the construction of specific projects, nor would projects be implemented under the direct authority of the Delta Stewardship Council. However, the Delta Plan seeks to improve water quality by encouraging various actions and projects, which if taken could lead to completion, construction and/or operation of projects that could improve water quality.

Actions would include implementation of plans/programs that lead to reduced constituents from agricultural runoff and wastewater treatment plants.

Associated projects could include construction and operation and maintenance of:

- Water treatment plants
- Conveyance facilities (pipelines and pumping plants)
- Wastewater treatment and recycle facilities
- Municipal stormwater treatment facilities
- Agricultural runoff treatment (eliminate, capture and treat/reuse)
- Wellhead treatment facilities
- Wells (withdrawal, recharge, and monitoring)

The number and location of all potential actions and projects that could be implemented is currently not known. Various projects, however, are known to some degree and are named in the Delta Plan. These are:

- Central Valley Drinking Water Policy
- Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS)
- Water Quality Control Plan Update for the San Francisco Bay/ Sacramento-San Joaquin Delta Estuary (water flow objectives update)
- SWRCB/Central Valley RWQCB Strategic Workplan
- Central Valley Pesticide Total Maximum Daily Load and Basin Plan Amendment for diazinon and chlorpyrifos
- Central Valley Pesticide Total Maximum Daily Load and Basin Plan Amendment for pyrethroids
- Total Maximum Daily Load and Basin Plan Amendments for selenium and methylmercury
- North Bay Aqueduct Alternative Intake Project

4.4.3.3.1 Impact 4-1c: Substantial Adverse Effects on Sensitive Natural Communities, Including Wetlands and Riparian Habitat

Actions encouraged by the Proposed Project to improve water quality, including projects that could result from the completion of the Central Valley Drinking Water Policy and the SWRCB/Central Valley RWQCB Strategic Workplan, could include water treatment plants, wastewater treatment plants, conveyance facilities, well installation, and wellhead treatment. CV-SALTS could possibly result in the construction of new wastewater treatment facilities. These facilities could be constructed throughout the Study Area. Similarly, the recommendations for the SWRCB and RWQCBs to develop and adopt objectives for nutrients in the Delta and Delta watershed and complete the processes underway for TMDL development also could result in the construction and operation of these types of facilities. The potential construction-related impacts on sensitive natural communities, including wetlands, would be similar to those described in Section 4.4.3.1 above for facilities to improve water supply reliability. Once constructed, these facilities would not be expected to adversely impact sensitive natural communities.

Discharges resulting from the operation of wastewater treatment plants could adversely influence wetlands and water quality if the discharges contained compounds or materials that produce direct toxicity or influence the growth of wetland plants or wetland-associated micro-organisms. However, the discharges associated with any new facilities would be regulated by the SWRCB and RWQCBs to ensure compliance with existing water quality standards and to prevent a substantial adverse effect on wetlands.

The Delta Plan encourages implementation of the North Bay Aqueduct Alternative Intake Project. The new North Bay Alternative Intake structure would be located on the Sacramento River in a rural area of Sacramento or Yolo County and the new pipeline would extend from the new intake structure to the existing North Bay Regional Water Treatment Plant. This diversion/intake structure and water conveyance pipeline would be similar to those associated with the Davis-Woodland Water Supply Project, which, while not named in the Delta Plan, provides analogous information. The Davis-Woodland Water Supply Project EIR (City of Davis et al. 2007) found that the project could mitigate significant impacts on wetlands and riparian vegetation to a less-than-significant level.

Actions encouraged by the Proposed Project to improve water quality also could include management and treatment of agricultural runoff. These types of actions could adversely affect wetlands or riparian vegetation if the footprint of those facilities occur within or in proximity to these sensitive natural communities or if the operation of the facilities altered the flow or quality of water that support those communities. The EIR for the Grasslands Bypass Project (Reclamation and San Luis & Delta-Mendota Water Authority 2008) illustrates some of the types of potential impacts associated with actions to improve the quality of agricultural drainage water. This project intercepts agricultural drainage water contaminated with salt, selenium, and boron and routes it away from wetlands used by wildlife. The EIR found that the project would either have no impact or improve wetlands relative to existing conditions.

Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies. However, because named projects and projects encouraged by the Proposed Project could result in substantial adverse effects on sensitive natural communities, this potential impact is considered **significant**.

4.4.3.3.2 Impact 4-2c: Substantial Adverse Effects on Special-status Species

Each of the projects and actions described in Section 4.4.3.3.1 above also has the potential to adversely affect special-status species. These facilities could be constructed throughout the Study Area. The potential construction-related impacts of actions encouraged by the Proposed Project to improve water quality on special-status species would be similar to or the same as those described in Section 4.4.3.1.2 above for facilities to improve water supply reliability.

The operation of facilities intended to improve water quality, such as discharges from wastewater treatment plants or the discharge of brine waste could adversely influence aquatic species if the discharges contained compounds or materials that produce direct toxicity or influence the aquatic food web. However, the discharges associated with any new facilities would be regulated by the SWRCB and RWQCBs to ensure compliance with existing water quality standards. Therefore, operation of these facilities would not be expected to produce significant impacts.

Completed CEQA documents for projects with characteristics similar to those listed above for water quality improvement provide perspective on the types of biological impacts that might result. For example, the EIRs for the Grasslands Bypass (Reclamation and San Luis & Delta-Mendota Water Authority 2008) and the Davis-Woodland Water Supply Project (City of Davis et al. 2007) are illustrative of some of the types of biological impacts associated with water quality improvement. Both of these analogous projects identified the potential for adverse impacts on special-status species. The Grassland Bypass project found that the water quality improvements (primarily reductions in selenium) associated with the project would be less than significant or beneficial. The Davis-Woodland project anticipated adverse effects on special-status species, but found that those impacts would be less than significant after mitigation.

Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies. However, because construction activities associated with named projects and projects encouraged by the Proposed Project could result in substantial adverse effects on special-status species, this potential impact is considered **significant**.

4.4.3.3.3 Impact 4-3c: Substantial Adverse Effects on Fish or Wildlife Species Habitat

The potential construction-related impacts on common fish or wildlife species habitat would be similar to those described above for substantial adverse effects on sensitive natural communities in Section 4.4.3.3.1.

The location and unique characteristics of most of the specific projects encouraged by the Proposed Project are currently not known. Similarly, the actual type and extent of impacts on fish and wildlife species habitat that could result from these projects are unclear. Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies. However, because named projects and projects encouraged by the Proposed Project could result in adverse effects on fish and wildlife species habitat, this potential impact is considered **significant**.

4.4.3.3.4 Impact 4-4c: Interfere Substantially with the Movement of Any Native Resident or Migratory Fish or Wildlife Species or with Established Native Resident or Migratory Wildlife Corridors

The construction of water quality improvement facilities and implementation of the programs listed in Section 4.4.3.3 could produce impacts on fish and wildlife movement similar to those described above for facility construction associated with water supply reliability (Section 4.4.3.1.3).

Operation of these facilities could result in new or increased discharges into water bodies that support migratory fish (e.g., Chinook salmon) and might produce localized interference with their movement. This potential impact is unlikely to be substantial because of the permitting requirements associated with these types of facilities. Similarly, programs to improve stormwater and agricultural runoff would be unlikely to produce significant adverse effects.

The EIR for an analogous project, the Davis-Woodland Water Supply Project (City of Davis et al. 2007), found that construction activities had the potential to interfere with fish and wildlife movement, specifically the movement of giant garter snakes and fish. These impacts were determined to be less than significant with the application of mitigation measures such as controlling erosion and the potential for increased turbidity in adjacent waterways. The impacts of operation on fish and wildlife movement were less than significant.

Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies. However, because named projects and projects encouraged by the Proposed Project could substantially interfere with the movement of fish and wildlife species, particularly during construction, this potential impact is considered **significant**.

4.4.3.3.5 Impact 4-5c: Conflict with Any Local Policies or Ordinances Protecting Biological Resources or the Provisions of an Adopted Habitat Conservation Plan, Natural Community Conservation Plan, or Other Approved Local, Regional, or State Habitat Protection Plan

The potential for water quality improvement actions to conflict with local policies, ordinances, and adopted HCPs and NCCPs would be similar to those described above for water supply reliability (Section 4.4.3.1.5). As with the categories of actions already discussed, it is unclear at this time how construction activities, including the location, number, methods, and duration, would be influenced by the Proposed Project. Similarly, the actual type and extent of potential conflicts with local policies and ordinances protecting biological resources and adopted local habitat protection plans are unclear. These potential impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies. Because the named projects and programs, and projects encouraged by the Proposed Project could conflict with local policies or ordinances as well as adopted HCPs, NCCPs, or other conservation plans, this potential impact is considered **significant**.

4.4.3.4 Flood Risk Reduction

As described in Sections 2A and 2B, the Delta Plan does not direct the construction of specific projects, nor would projects be implemented under the direct authority of the Delta Stewardship Council. However, the Delta Plan seeks to reduce the risk of floods in the Delta by encouraging various actions that, if taken, could lead to completion, construction and/or operation of projects that could reduce flood risks in the Delta. Such projects and their features could include the following:

- Setback levees
- Floodplain expansion
- Levee maintenance
- Levee modification
- Dredging
- Stockpiling of rock for flood emergencies
- Subsidence reversal
- Reservoir reoperation

The number and location of all potential projects that would be implemented are not known at this time. One possible project, however, is known to some degree and is named in the Delta Plan, specifically the Sacramento Deep Water Ship Channel and Stockton Deep Water Ship Channel Dredging (the United States Army Corps of Engineer's *Delta Dredged Sediment Long-Term Management Strategy* included in Appendix C, Attachment C-7 of this EIR). The Proposed Project also names DWR's *A Framework for Department of Water Resources Investments in Delta Integrated Flood Management*, which could, upon completion, provide guidance on the prioritization flood protection investments.

4.4.3.4.1 Impact 4-1d: Substantial Adverse Effects on Sensitive Natural Communities, Including Wetlands and Riparian Habitat

Actions encouraged by the Proposed Project to reduce flood risk could adversely affect sensitive natural communities, including wetlands, through physical disturbance or removal during construction of facilities or through changes in flows, such as could occur with reoperating reservoirs. These activities would occur primarily within and near the Delta, although reservoir reoperation could affect areas within the Delta watershed more broadly. Impacts of levee modification and floodplain enhancement actions would result primarily in temporary, construction-related impacts. Reservoir reoperation, however, could result in long-term impacts if the changes in operation to facilitate flood control adversely affect sensitive wetland and riparian habitats by altering the magnitude, duration, and timing of flows.

The construction and modification of levees, such as those that could result from completion of DWR's investment framework, could directly impact adjacent riparian vegetation and wetlands within the construction footprint. The impacts on riparian vegetation could be more pronounced if the variance to the USACE Levee Vegetation Policy sought by the Delta Plan is not granted. Under this policy, all vegetation on or immediately adjacent to the levee would be removed and maintained in that condition. This could apply to existing established riparian vegetation that supports wildlife. The establishment of setback levees could result in a long-term increase in wetland and riparian habitat in floodplains that would be reconnected to stream and slough channels.

In addition to setback levees, the Proposed Project could encourage levee projects that improve flood protection and the reliability of Delta waterways as conveyance channels. These projects could adversely affect near-shore sensitive natural communities such as tidal wetlands and riparian scrub and forest if they result in river bank armoring that removes natural substrates. Ongoing maintenance of the levees and vegetation management could result in removal of riparian trees and shrubs. These activities could result in long-term effects on riparian vegetation.

Flood risk reduction actions that increase the size of floodplains would have impacts similar to those described for floodplain restoration associated with ecosystem restoration in Section 4.4.3.2.1. Most of the types of projects encouraged by the Proposed Project would likely be designed to simultaneously achieve flood risk reduction and ecosystem restoration objectives, including any actions resulting from the Delta Plan recommendation to implement a bypass and floodway on the San Joaquin River near Paradise Cut that would reduce the flood stage on the mainstem San Joaquin River adjacent to the urban and urbanizing communities of Stockton, Lathrop, and Manteca.

The Proposed Project also would encourage the development of sites to stockpile rock for use in flood emergencies. These activities could affect sensitive natural communities (riparian) located on or near these sites. The Initial Study and Proposed Mitigated Negative Declaration for DWR's Delta Emergency Rock and Transfer Facilities Project (DWR 2007d) provides analogous information on the types of impacts that could result from these kinds of activities. In this environmental document, DWR evaluated the environmental effects of stockpiling rock and setting up barge loading facilities at strategic locations around the Delta for use during emergency flood fighting operations in the event of a catastrophic flooding event in the Delta. Rock stockpiling and barge loading facilities that would be part of the proposed project would be located at the Port of Stockton in Stockton, on property along the Sacramento River in Hood, and on state-owned land in Rio Vista. Based on the evaluation, DWR concluded that the project could significantly affect riparian communities, but that the impacts could be mitigated to a less-than-significant level.

Activities to reduce flood risk or increase channel depths could include dredging in and near the Delta. These activities could occur as part of maintenance of the Sacramento Deep Water Ship Channel and Stockton Deep Water Ship Channel Dredging as described in Section 2A, Proposed Project and Alternatives, for the Delta Dredged Sediment Long-Term Management Strategy. Dredging actions

encouraged by the Proposed Project have the potential to produce temporary, but periodic, increases in turbidity, re-suspend toxic materials, and reduce downstream sediment supplies that could adversely affect tidal wetlands. These activities also could affect sensitive natural communities, including wetlands, in areas where the dredged material is deposited.

The Draft Supplemental EIS/Subsequent EIR for the Sacramento River Deep Water Ship Channel (USACE and the Port of West Sacramento 2011), a project that is both identified in the Proposed Project recommendations and serves as an example of dredging projects, analyzed proposed dredging activities. USACE determined that wetlands and other sensitive habitats would not be affected by the dredging, including the placement of dredged materials, and that mitigation was not necessary.

The implementation of projects and actions to reduce flood risk would have the greatest potential to adversely impact sensitive natural communities during construction. Once constructed, levees and reconnected floodplains would not be expected to result in significant impacts. Dredging and the placement of dredged materials could result in impacts as channels are periodically dredged to maintain channel capacity.

Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies. However, because named projects and projects encouraged by the Proposed Project could result in substantial adverse effects on sensitive natural communities, this potential impact is considered **significant**.

4.4.3.4.2 Impact 4-2d: Substantial Adverse Effects on Special-status Species

Actions encouraged by the Proposed Project to reduce flood risk could affect special-status species inhabiting areas near or adjacent to levee construction or modification, including the construction of setback levees. The construction of setback levees could result in temporary construction disturbance in the footprint of the project, but ultimately increase habitat for species that use floodplain and riparian woodlands as habitat. However, levee construction, might remove agricultural land and reduce habitat for species associated with agriculture. The maintenance of these levees and routine vegetation control to USACE standards could result in localized disturbance to special-status species inhabiting areas adjacent to the levee. For example, levee maintenance activities could disturb nesting Swainson’s hawks and other nesting raptors. Obtaining a variance to the levee vegetation policy would reduce these impacts.

These types of construction impacts were evaluated in the EIR for the North Delta Flood Control and Ecosystem Restoration Project (DWR 2010), a named project that provides an assessment of impacts that are analogous to the levee construction activities encouraged by the Delta Plan. For that project, the lead agency identified potential significant impacts to several special-status fish, wildlife, and plant species, including valley elderberry longhorn beetle, greater sandhill crane, and Swainson’s hawk, during construction due to direct losses and disturbance; however, these impacts were determined to be less than significant after mitigation.

The Proposed Project also could encourage levee projects that improve flood protection and the reliability of Delta waterways as conveyance channels. These projects could adversely affect near-shore terrestrial and aquatic habitat of special-status species if they result in river bank armoring that removes natural substrates. The permanent removal of riparian vegetation near the water’s edge could reduce the shading and recruitment of woody material into the channel that improves the quality of habitat for juvenile special-status salmonids and other species. Ongoing maintenance of the levees and vegetation management could result in disturbance to special-status species inhabiting areas adjacent to the levees.

Reoperation of reservoirs to support flood risk reduction could adversely affect special-status fish species, such as Chinook salmon, if the flow changes scour or dewater spawning areas or lead to stranding of juvenile fish. Reoperation also could impact special-status fish if the flow changes adversely influence water temperatures.

The development of rock stockpiles within the Delta could adversely affect special status fish, wildlife, and plants. The Initial Study and Proposed Mitigated Negative Declaration for DWR's Delta Emergency Rock and Transfer Facilities Project (DWR 2007d) found the potential for significant impacts on special status species, but concluded that the impacts would be less than significant with mitigation.

Dredging activities associated with flood risk reduction encouraged by the Proposed Project could adversely impact special-status species directly or indirectly through destruction and modification of habitat or reduction in prey availability. The Delta Plan encourages implementation of the Sacramento Deep Water Ship Channel and Stockton Deep Water Ship Channel Dredging Project. These actions have the potential to adversely affect special-status species directly through entrainment, temporary increases in turbidity, and re-suspension of toxic materials. These activities also could affect special-status wildlife and plant species and their habitat in areas where the dredged material is deposited.

The Draft Supplemental EIS/Subsequent EIR for the Sacramento River Deep Water Ship Channel (USACE and Port of West Sacramento 2011), a project that is both encouraged by the Proposed Project and serves as an example of dredging projects, analyzed proposed dredging activities, and found that potential impacts to special-status species could be significant. However, the lead agency found that, except for loss or degradation of designated critical habitat for delta smelt, these impacts could be mitigated to less-than-significant levels. Impacts to delta smelt critical habitat remained potentially significant after mitigation.

Construction impacts associated with levees and floodplains would be temporary in nature, although armoring of levee banks or permanently removing riparian vegetation would have long-term effects. The effects of dredging also would be temporary, but would continue periodically into the future as additions dredging is required.

Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies. However, because named projects and projects encouraged by the Proposed Project could result in substantial adverse effects on special-status species, this potential impact is considered **significant**.

4.4.3.4.3 Impact 4-3d: Substantial Adverse Effects on Fish or Wildlife Species Habitat

Actions encouraged by the Proposed Project to reduce flood risk could affect fish and wildlife species habitat as was described for sensitive natural communities in Section 4.4.3.4.1 and for special-status species habitat described in Section 4.4.3.4.2. The EIRs for flood risk reduction projects similar to those encouraged by the Proposed Project cited in Section 4.4.3.4.1 all found that potential impacts to fish and wildlife species habitat associated with these projects were either less than significant or less than significant with mitigation.

The location and unique characteristics of most of the specific projects encouraged by the Proposed Project are currently not known. Similarly, the actual type and extent of impacts on fish and wildlife species habitat that could result from these projects are unclear. Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies. However, because named projects and projects encouraged by the Proposed Project could result in substantial adverse effects on fish and wildlife species habitat, this potential impact is considered **significant**.

4.4.3.4.4 Impact 4-4d: Interfere Substantially with the Movement of Any Native Resident or Migratory Fish or Wildlife Species or with Established Native Resident or Migratory Wildlife Corridors

Levee construction could temporarily interfere with the movement of native wildlife species that use riparian corridors or shoreline adjacent to the levees. This could result in a longer term impact on local and migratory movement if existing vegetation is removed during construction or the levee creates a barrier to migration and movement. The potential loss of riparian vegetation also could adversely affect colonial nesting birds. Dredging could temporarily disrupt the local and migratory movement of fish by creating in-river disturbance, including vibration and increased turbidity.

The EIR for the North Delta Flood Control and Ecosystem Restoration Project (DWR 2010) and the Sacramento River Deep Water Ship Channel (USACE and Port of West Sacramento 2011) did not specifically address the impacts of those projects on fish and wildlife movement and migration.

Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies. However, because named projects and projects encouraged by the Proposed Project could substantially interfere with the movement of fish and wildlife species, this potential impact is considered **significant**.

4.4.3.4.5 Impact 4-5d: Conflict with Any Local Policies or Ordinances Protecting Biological Resources or the Provisions of an Adopted Habitat Conservation Plan, Natural Community Conservation Plan, or Other Approved Local, Regional, or State Habitat Protection Plan

The construction and modification of levees could result in impacts on biological resources that are protected under local policies and ordinances (e.g., heritage trees) if these resources occur in the footprint of construction activities. Dredging also could conflict with these policies, particularly in areas where dredged material is deposited. Levee construction/maintenance and dredging also could occur within the boundaries of the San Joaquin County Multi-Species Habitat Conservation and Open Space Plan. Levee maintenance is an activity that is covered by that plan; dredging is not. Once constructed, facilities to reduce flood risk would not likely conflict with local policies and ordinances.

Activities encouraged by the Proposed Project to reduce flood risk might conflict with local policies and ordinances and an adopted conservation plan. The location and characteristics of most of the specific projects encouraged by the Proposed Project are currently not known. Similarly, the actual type and extent of conflicts with local policies and ordinances protecting biological resources, or with adopted local habitat protection plans in the Delta, Delta watershed, or areas outside the Delta that use Delta water are unclear. Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies and it is likely that these types of impacts could be mitigated to a less-than-significant level. However, because the named projects and projects encouraged by the Proposed Project could conflict with local policies or ordinances and adopted HCPs, this potential impact is considered **significant**.

4.4.3.5 Protection and Enhancement of Delta as an Evolving Place

As described in Sections 2A and 2B, the Delta Plan does not direct the construction of specific projects, nor would projects be implemented under the direct authority of the Delta Stewardship Council. However, the Delta Plan seeks to protect and enhance the Delta as an evolving place by encouraging various actions and projects that, if taken, could lead to completion, construction and/or operation of associated projects. Features of such actions and could include the following:

- Gateways, bike lanes, parks, trails, and marinas and facilities to support wildlife viewing, angling, and hunting opportunities
- Additional retail and restaurants in legacy towns to support tourism

The number and location of all potential projects that could be implemented are not known at this time. However, several possible projects are known to some degree and are named in the Delta Plan, which are new State parks at Barker Slough, at Elkhorn Basin and in the southern Delta, and the Economic Stability Plan.

4.4.3.5.1 Impact 4-1e: Substantial Adverse Effects on Sensitive Natural Communities, Including Wetlands and Riparian Habitat

Community gateways, bike lanes, trails, and facilities to support wildlife viewing, angling, and hunting could be established in the Delta to protect and enhance it as an evolving place (see Section 18 [Recreation] for additional description of these facilities and activities). The construction and use of these recreational facilities encouraged by the Proposed Project could result in adverse effects on sensitive natural communities, including wetlands, if they occur in the area of construction disturbance. The establishment of parks in areas such as Barker Slough, Elkhorn Basin, and the southern Delta could result in the removal of small amounts of wetlands and riparian habitat to accommodate park facilities. All of these activities could have localized construction-related impacts as well the potential for ongoing, long-term disturbance associated with recreational use. Actions such as the development and operation of new marinas and fishing access points in the Delta could have temporary, construction-related impacts on tidal marsh and riparian communities. And the increased boating and fishing activity encouraged by these recreational improvements could result in damage to tidal wetlands and riparian habitat from boat wakes, adverse water quality impacts from boating and other discharges, and in disturbance from trampling from fishing and other human activities along the shoreline.

While the specific impacts of many of these projects, if they go forward, are yet to be determined, projects recently evaluated under CEQA with characteristics similar to those described above for protection and enhancement of the Delta as an evolving place provide perspective on the types of impacts that might result. The programmatic EIR for the development of San Luis Rey River Park in northern San Diego County (San Diego County Department of Parks and Recreation 2008), a project analogous to those encouraged in the Delta, found that the impacts of park construction, trails, and trail bridges could result in disturbance that could adversely affect sensitive natural communities, riparian habitats, and federal wetlands and waters. These impacts were mitigated to less-than-significant levels through restoration of affected habitats or, in cases where impacts were permanent, through off-site mitigation.

Construction-related impacts associated with recreational facilities and parks would be temporary. The effects of recreational use of the facilities would be long term.

Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies. However, because named projects and projects encouraged by the Proposed Project could result in substantial adverse effects on sensitive natural communities, this potential impact is considered **significant**.

4.4.3.5.2 Impact 4-2e: Substantial Adverse Effects on Special-status Species

The construction of recreational facilities described above in Section 4.4.3.5.1 could result in adverse effects on special-status species that inhabit the area. Use of these facilities could result in disturbance of and a reduction in the quantity, quality, and suitability of habitat for special-status species in and adjacent to the construction footprint. The establishment of parks in areas such as Barker Slough, Elkhorn Basin, and the southern Delta could result in the removal of small amounts of habitat (as described for sensitive communities) and increase the potential for disturbance of special-status species by park users.

While the specific impacts of many of these projects, if they go forward, are yet to be determined, projects recently evaluated under CEQA with characteristics similar to those described above for protection and enhancement of the Delta as an evolving place provide perspective on the types of impacts on special-status species that might result. For example, the final EIR for the Bidwell–Sacramento River State Park Habitat Restoration and Outdoor Recreation Facilities Development Project (The Nature Conservancy and California Department of Parks and Recreation 2008), which is illustrative of some of the types of biological impacts associated with park development and recreational facilities, found that the project had the potential to impact to valley elderberry longhorn beetle, but that the impact would be less than significant. Similarly, the programmatic EIR for the development of San Luis Rey River Park in northern San Diego County (San Diego County Department of Parks and Recreation 2008) found that the project had the potential to impact the special-status arroyo toad or convert suitable upland toad habitat such that it would become unsuitable for the species. These potential impacts were determined to be less than significant with mitigation.

Actions such as the development of new marinas and fishing access points in the Delta could have temporary, construction-related impacts on local special-status fish, wildlife, and plants. The increased boating and fishing activity encouraged by these recreational improvements could increase disturbance of special-status species associated with shoreline and riparian habitats. For example, Mason's lilaeopsis is susceptible to erosion from boat wakes and trampling from fishing and other human activities along the shoreline.

All of the above activities implemented to protect and enhance the Delta as an evolving place could have localized construction-related impacts as well the potential for ongoing, long-term disturbance associated with recreational use. Activities carried out to improve tourism in developed areas would not likely impact special-status species.

Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies. However, because named projects and projects encouraged by the Proposed Project could result in substantial adverse effects on special-status species, this potential impact is considered **significant**.

4.4.3.5.3 Impact 4-3e: Substantial Adverse Effects on Fish or Wildlife Species Habitat

Construction of recreational facilities and other projects that would protect and enhance the Delta as an evolving place would likely result in removal of small amounts of fish and wildlife species habitat. The potential construction- and disturbance-related impacts on common fish or wildlife species habitat would be similar to those described above for sensitive natural communities and special-status species habitat in Sections 4.4.3.5.1 and 4.4.3.5.2. However, because the location and unique characteristics of most of the specific projects encouraged by the Proposed Project are currently not known, the impacts of these projects on fish and wildlife species habitat are considered **significant**.

4.4.3.5.4 Impact 4-4e: Interfere Substantially with the Movement of Any Native Resident or Migratory Fish or Wildlife Species or with Established Native Resident or Migratory Wildlife Corridors

Actions that increase recreational use of natural areas and waterways in the Delta have the potential to disturb fish and wildlife. Depending on the specific locations and habitats affected, this increase in disturbance could interfere with local and migratory movements of native fish and wildlife. The EIRs for San Luis Rey River Park and Bidwell–Sacramento River State Park Habitat Restoration and Outdoor Recreation Facilities Development Project did not specifically address impacts on fish and wildlife movement.

Because the location and unique characteristics of most of the specific projects encouraged by the Proposed Project are currently not known, these projects have the potential to interfere substantially with the movement of fish and wildlife species. This potential impact is considered **significant**.

4.4.3.5.5 Impact 4-5e: Conflict with Any Local Policies or Ordinances Protecting Biological Resources or the Provisions of an Adopted Habitat Conservation Plan, Natural Community Conservation Plan, or Other Approved Local, Regional, or State Habitat Protection Plan

The potential to conflict with local policies or ordinances protecting biological resources or the provisions of an HCP or NCCP resulting from levee construction and maintenance conducted to protect and enhance the Delta as an evolving place would be the same as those described in Section 4.4.3.4.5 (flood risk reduction).

Actions to develop gateways, bike lanes, parks, trails, and marinas and facilities to support wildlife viewing, angling, and hunting opportunities could conflict with local policies and ordinances or the San Joaquin County Multi-Species Habitat Conservation and Open Space Plan and the East Contra Costa County HCP/NCCP, depending on the location and type of activity. The encouragement of additional retail and restaurants in legacy towns to support tourism under the Proposed Project would not likely result in conflicts with these policies and plans.

Project-level impacts would be addressed in future site-specific environmental analysis conducted at the time such projects are proposed by lead agencies. Although named projects and projects encouraged by the Proposed Project are not likely to conflict with adopted HCPs, NCCPs, or other conservation plans, they could conflict with local policies or ordinances. Therefore, this potential impact is considered **significant**.

4.4.3.6 Mitigation Measures

Any covered action that would have one or more of the significant environmental impacts listed above shall incorporate the following features and/or requirements related to such impacts.

With regard to covered actions implemented under the Delta Plan, these mitigation measures will reduce the impacts of the Proposed Project. Project-level analysis by the agency proposing the covered action will determine whether the measures are sufficient to reduce those impacts to a less-than-significant level. Generally speaking, many of these measures are commonly employed to minimize the severity of an impact and in many cases would reduce impacts to a less-than-significant level, as discussed below in more detail.

With regard to actions taken by other agencies on the basis of Delta Plan recommendations (i.e., activities that are not covered actions), the implementation and enforcement of these measures would be within the responsibility and jurisdiction of public agencies other than the Delta Stewardship Council. Those agencies can and should adopt these measures as part of their approval of such actions, but the Delta Stewardship Council does not have the authority to require their adoption. Therefore, significant impacts of noncovered actions could remain **significant and unavoidable**.

How mitigation measures in this EIR relate to covered and noncovered actions is discussed in more detail in Section 2B, Introduction to Resource Sections.

4.4.3.6.1 Mitigation Measure 4-1

The following mitigation measures would reduce the effects of Impact 4-1a through e, Substantial Adverse Effects on Sensitive Natural Communities, Including Wetlands and Riparian Habitat:

- Avoid, minimize, and compensate for reduction in area and/or habitat quality of sensitive natural communities, including wetlands, by doing the following:
  - Selecting project site(s) that would avoid sensitive natural communities, including jurisdictional wetlands and other waters, vernal pools, alkali seasonal wetlands, riparian habitats, and inland dune scrub.
  - Designing, to the maximum extent practicable, project elements to avoid effects on sensitive natural communities.
  - Replacing, restoring, or enhancing on a “no net loss” basis (in accordance with USACE and SWRCB requirements), wetlands and other waters of the United States and waters of the State that would be removed, lost, and/or degraded.
  - Where impacts to sensitive natural communities other than waters of the United States or State are unavoidable, compensating for impacts by restoring and/or preserving in-kind sensitive natural communities on-site, or off-site at a nearby site, or by purchasing in-kind restoration or preservation credits from a mitigation bank that services the project site and that is approved by the appropriate agencies , in consultation with applicable regulatory agencies (at ratios that offset temporal loss of habitat value).
- Implement construction best management practices, including:
  - Developing and implementing a Stormwater Pollution Prevention Plan (SWPPP).
  - Minimizing soil disturbance, erosion, and sediment runoff from project site.
  - Avoiding and minimizing contaminant spills.
  - Minimizing visual and noise disturbance from construction activities.
  - Conducting biological construction monitoring to ensure that implemented BMPs are effective.
- Restore areas temporarily affected by construction activities, including:
  - Preparing restoration plan for temporary impacts sites for review by resource agencies.
  - Minimizing soil disturbance and stockpiling topsoil for later use in any areas to be graded.
  - Decompacting or amending soil if necessary before planting and use native species for revegetation.

- Restoring natural communities with similar or improved function from communities that were affected.

♦ If a project may result in conversion of oak woodlands, as identified in section 21083.4 of the Public Resources Code, one or more of the following mitigation measures shall be implemented:

- Conserve oak woodlands, through the use of conservation easements.
- Plant an appropriate number of trees, including maintaining plantings and replacing dead or diseased trees.
- Contribute funds to the Oak Woodlands Conservation Fund, as established under subdivision (a) of section 1363 of the Fish and Game Code.

♦ An invasive species management plan shall be developed and implemented for any project to ensure that invasive plant species and populations are kept below preconstruction abundance and distribution levels. The plan shall be based on the best available science and developed in consultation with DFG and local experts, such as the University of California Extension, county agricultural commissioners, representatives of County Weed Management Areas (WMA), California Invasive Plant Council, and California Department of Food and Agriculture. The invasive species management plan will include the following elements:

- Nonnative species eradication methods (if eradication is feasible)
- Nonnative species management methods
- Early detection methods
- Notification requirements
- Best management practices for preconstruction, construction, and post construction periods
- Monitoring, remedial actions and reporting requirements
- Provisions for updating the target species list over the lifetime of the project as new invasive species become potential threats to the integrity of the local ecosystems

4.4.3.6.2 Mitigation Measure 4-2

The following mitigation measures would reduce the effects of Impact 4-2a through e, Substantial Adverse Effects on Special-status Species:

♦ Select project site(s) that would avoid habitats of special-status species (which may include foraging, sheltering, migration and rearing habitat in addition to breeding or spawning habitat), and to the maximum extent practicable, (re)design project elements to avoid effects on such species.

♦ Schedule construction to avoid special-status species' breeding, spawning, or migration locations during the seasons or active periods that these activities occur.

♦ Conduct preconstruction surveys (by a qualified biologist) for special-status species in accordance with USFWS, NMFS and DFG survey methodologies and appropriate timing to determine presence and locations of any special-status species and their habitat, and avoid, minimize, or compensate for impacts to special-status species in coordination with DFG and USFWS or NMFS.

- Establish buffers around special-status species habitats to exclude effects of construction activities. The size of the buffer shall be in accordance with USFWS and DFG protocols for the applicable special-status species. If nest tree removal is necessary, remove the tree only after the nest is no longer active, as determined by a qualified biologist.
- Conduct construction monitoring (by qualified biologist) to ensure effectiveness of avoidance and minimization measures and implement remedial measures if necessary.
- When appropriate, relocate special-status plant and animal species or their habitats from project sites following USFWS, NMFS, and DFG protocols (e.g., for special-status plant species or elderberry shrubs).
- Where impacts to special-status species are unavoidable, compensate for impacts by restoring or preserving in-kind suitable habitat on-site, or off-site, or by purchasing restoration or preservation credits (in compliance with CESA and ESA) for affected State- or federally-listed species from a mitigation bank that serves the project site and that is approved by the appropriate agencies, in consultation with the appropriate regulatory agencies (at ratios that offset the temporary loss of habitat value).

4.4.3.6.3 Mitigation Measure 4-3

The following mitigation measures would reduce the effects of Impact 4-3a through e, Substantial Adverse Effects on Fish or Wildlife Species Habitat:

- Select project site(s) that would avoid a substantial reduction in fish and wildlife species habitat.
- To the maximum extent practicable, design project elements to avoid effects that would lead to a substantial loss of fish and wildlife habitat.
- Replace, restore, or enhance habitats for fish and wildlife species that would be lost.
- Where substantial loss of habitat for fish and wildlife species is unavoidable, compensate for impacts by preserving in-kind habitat.

4.4.3.6.4 Mitigation Measure 4-4

The following mitigation measures would reduce the effects of Impact 4-4a through e, Interfere Substantially with the Movement of Any Native Resident or Migratory Fish or Wildlife Species or with Established Native Resident or Migratory Wildlife Corridors:

- Protect habitat for migratory waterfowl and shorebirds by expanding existing wildlife refuges and management areas, and establishing new ones in or near wetland areas used by migratory waterfowl and shorebirds. Manage these areas by establishing suitable vegetation, hydrology and other habitat components to optimize the use by migratory waterfowl and shorebirds.
- Protect, restore and enhance connectivity of habitats, including but not limited to wetland and riparian habitats that function as migration corridors for wildlife species. Acquire areas with potential to increase connectivity between existing habitats, protect these areas in perpetuity through the acquisition of conservation easements, deed restrictions, or similar tools, and restore the habitat for wildlife species in these areas. Habitat restoration might be accomplished by establishing suitable hydrology or other physical conditions for desirable vegetation, planting desirable vegetation, fencing and managing grazing, and other means.

- Protect migratory pathways for migratory aquatic species such as salmon, steelhead, and sturgeon including those that use Delta tributaries and floodplain habitats by screening diversions, and removing migration barriers.
- Avoid or minimize alteration of flow patterns and water quality effects that could disrupt migratory cues for migratory aquatic species by implementing water management measures and establishing programs to reduce water pollution.

4.4.3.6.5 Mitigation Measure 4-5

The following mitigation measure would reduce the effects of Impact 4-5a through e, Conflict with Any Local Policies or Ordinances Protecting Biological Resources or the Provisions of an Adopted Habitat

Conservation Plan, Natural Community Conservation Plan, or Other Approved Local, Regional, or State Habitat Protection Plan:

- Prior to construction, evaluate impacts to trees or other biological resources protected by local policies and ordinances, and abide by any permit requirements associated with these policies and ordinances.

4.4.4 No Project Alternative

As described in Section 2A, Proposed Project and Alternatives, the No Project Alternative is based on the continuation of existing plans and policies and the continued operation of existing facilities into the future and permitted and funded projects. Seven ongoing projects have been identified as part of the No Project Alternative. The list of projects included in the No Project Alternative is presented in Table 2-2.

The No Project Alternative includes various water supply projects and one ecosystem enhancement project, as described in Section 2A, Proposed Project and Alternatives. These generally would have the same types of impacts on biological resources as would occur under the Proposed Project. However, the Delta Plan would not be in place to encourage various other projects to move forward. To the extent the absence of the Delta Plan results in those projects not happening, there would be no biological resource impacts associated with them.

As with all of the alternatives including the No Project Alternative, biological resources would be influenced by climate change and sea level rise. As described in Section 21 (Climate Change and Greenhouse Gas Emissions), climate change will strongly influence the aquatic environment by shifting the mix of precipitation in favor of more rainfall and less snow, which would lead to earlier melting of the snow pack in the Sierra Nevada and more variable flow events. This likely would shift the timing of peak flows and increase water temperatures. These changes could make portions of the Delta and its tributaries more stressful or unsuitable for some aquatic species, while potentially benefiting nonnative species. Changes in the distribution and extent of precipitation could also change the distribution and composition of plant and wildlife communities. Aquatic and terrestrial communities would also be influenced by sea level rise. Compared to the Proposed Project, the No Project Alternative would result in fewer actions and projects to improve water supply reliability, restore the Delta ecosystem, improve water quality, reduce flood risk, and protect and enhance the Delta as an evolving place. Overall, the reduced number of projects and actions under the No Project Alternative would reduce the impacts on biological resources resulting from construction and operation of those projects. In addition to a general reduction in the number of projects with relatively small construction footprints, the large-scale surface water storage facilities and increased levee modification and maintenance encouraged under the Proposed Project would not move forward under the No Project Alternative, and the impacts associated with these projects would not occur.

Importantly, however, the benefits to biological resources resulting from ecosystem restoration and projects that support habitat development (e.g., setback levees and floodplain expansion), and improvements to Delta water quality, would not be realized under the No Project Alternative. As described in Section 2A, Proposed Project and Alternatives, and Section 4.3, Environmental Setting, conditions in the Delta for biological resources have declined and continue to decline, primarily as a result of human influences on the ecosystem. The listing of several species that inhabit the Delta as endangered or threatened under federal and State law serve as evidence of a degraded and declining environment for those species. Major changes in the Delta food web and the establishment of nonnative invasive species also point to a deteriorating condition for sensitive natural communities and native species. Given the reduced number and magnitude of actions under the No Project Alternative (e.g., large-scale ecosystem restoration and an improved flow regime) to improve the current conditions or arrest further decline, on balance the overall adverse impacts on biological resources resulting from the No Project Alternative would be **greater than** those under the Proposed Project, even though temporary impacts from construction would be fewer.

4.4.5 Alternative 1A

Under Alternative 1A, the construction and operation of surface water projects (water intakes, treatment and conveyance facilities, and reservoirs) would be the same as the Proposed Project. As described in Section 2A, Proposed Project and Alternatives, there would be fewer groundwater projects (wells, wellhead treatment, conveyance facilities, ocean desalination projects, recycled wastewater and stormwater projects (treatment and conveyance facilities), water transfers, and water use efficiency and conservation programs would be reduced relative to the Proposed Project.

Projects to restore the Delta ecosystem would be reduced relative to the Proposed Project and the implementation of flow objectives that could lead to a more natural flow regime in the Delta would not be accelerated. Stressor management activities and invasive species management (including removal of invasive vegetation) would be the same as described for the Proposed Project.

Projects and actions to improve water quality would be the same as under the Proposed Project. Flood risk reduction projects also would be the same as under the Proposed Project, except that less emphasis on levee maintenance and modification for levees that protect agricultural land and more emphasis on levees that protect water supply corridors, which could result in an overall reduction in these activities. Projects to protect and enhance the Delta as an evolving place would be the same as for the Proposed Project.

4.4.5.1.1 Impact 4-1: Substantial Adverse Effects on Sensitive Natural Communities, Including Wetlands

Impacts on sensitive natural communities would be increased under Alternative 1A compared to the Proposed Project because it would do less than the Proposed Project to arrest the decline of natural communities described in Section 4.3, Environmental Setting. Primarily, this results from fewer projects and efforts to restore the Delta ecosystem under this Alternative than the Proposed Project, including delayed (as compared to the Proposed Project) implementation of more natural flows to the Delta (flows enhance wetland and riparian habitat which in turn support declining special-status species).

To the extent construction would have temporary impacts on sensitive communities, these impacts would be reduced under Alternative 1A compared to the Proposed Project because Alternative 1A generally involves less than the Proposed Project.

Given the reduced number and magnitude of actions under the Alternative 1A (e.g., large-scale ecosystem restoration and an improved flow regime) to improve the current conditions or arrest further decline, on balance the overall adverse impacts on sensitive natural communities resulting from Alternative 1A would be **greater than** those under the Proposed Project, even though temporary impacts from construction might be fewer and the potential for groundwater effects might be reduced.

Compared to existing conditions, the impacts on sensitive natural communities under Alternative 1A would be **significant**.

4.4.5.1.2 Impact 4-2: Substantial Adverse Effects on Special-status Species

Impacts on special-status species would be increased compared to the Proposed Project under Alternative 1A because implementation of a more natural flow regime to the Delta and Delta tributaries would be delayed (as compared to the Proposed Project), which would delay the benefits to native special-status species in the Delta and Delta tributaries. In addition, Alternative 1A would not restore as much habitat in the Delta as would the Proposed Project, and would it not create as much benefit for certain special-status species. A reduced level of flood protection for agricultural land would increase the risk of loss of agricultural land which provides habitat for species such as greater sandhill crane, although flooding of that land also could create new aquatic habitat.

Temporary construction impacts under Alternative 1A would be fewer because there would be fewer facilities constructed. Also, potential impacts associated with fallowing (i.e., temporary reduction in habitat for special-status species that use agricultural land) would be reduced because water transfers would not be emphasized.

Given the reduced number and magnitude of actions under the Alternative 1A (e.g., large-scale ecosystem restoration and an improved flow regime) to improve the current conditions or arrest further decline, on balance the adverse impacts on sensitive natural communities resulting from Alternative 1A would be **greater than** those of the Proposed Project, even though temporary impacts from construction might be fewer and the potential for temporary reductions in fallowing caused by water transfers might be reduced.

Compared to existing conditions, the impacts on special-status species under Alternative 1A would be **significant**.

4.4.5.1.3 Impact 4-3: Substantial Reduction of Fish or Wildlife Species Habitat

Impacts on fish and wildlife habitat would the same as those described for sensitive natural communities in Section 4.4.5.1.1, above.

Overall, significant impacts on fish and wildlife habitat under Alternative 1A would be **less than** under the Proposed Project.

Compared to existing conditions, the impacts on fish and wildlife habitat under Alternative 1A would be **significant**.

4.4.5.1.4 Impact 4-4: Interfere Substantially with the Movement of Any Native Resident or Migratory Fish or Wildlife Species or with Established Native Resident or Migratory Wildlife Corridors

Alternative 1A would reduce the construction impacts associated with groundwater projects, ocean desalination projects, recycled wastewater and stormwater projects because fewer facilities would be constructed and the reduction in levee modification and maintenance under Alternative 1A could reduce the potential for interference with fish and wildlife movement along waterways and riparian corridors that adjoin most levees. The potential for substantial interference with the movement of fish and wildlife

under Alternative 1A, however, would be increased relative to the Proposed Project because the implementation of new flow standards that support fish migration would not be achieved as early and habitat restoration, particularly in floodplain areas that support movement and migration, would not be as extensive.

Given the reduced number and magnitude of actions under Alternative 1A (e.g., large-scale ecosystem restoration and an improved flow regime) to improve the current conditions or arrest further decline, on balance the overall adverse impacts on fish and wildlife movement resulting from Alternative 1A would be **greater than** those under the Proposed Project, even though temporary impacts from construction and levee maintenance might be fewer.

Compared to existing conditions, the impacts on fish and wildlife movement under Alternative 1A would be **significant**.

4.4.5.1.5 Impact 4-5: Conflict with Any Local Policies or Ordinances Protecting Biological Resources or the Provisions of an Adopted Habitat Conservation Plan, Natural Community Conservation Plan, or Other Approved Local, Regional, or State Habitat Protection Plan

The same type of conflicts with local policies and ordinances protecting biological resources, or with adopted local habitat protection plans would occur under Alternative 1A as described under the Proposed Project. The projects and actions under Alternative 1A have the potential to conflict with these policies, ordinances, and plans, but because there would fewer projects constructed, these conflicts would be less likely.

Overall, significant impacts associated with conflicts with these policies, ordinances, and plans under Alternative 1A would be **less than** under the Proposed Project.

Compared to existing conditions, the impacts resulting from these conflicts with policies, ordinances, and plans under Alternative 1A would be **significant**.

4.4.5.2 Mitigation Measures

Mitigation measures for impacts associated with Alternative 1A would be the same as those described for the Proposed Project in Sections 4.4.3.6.1 (Mitigation Measure 4-1), 4.4.3.6.2 (Mitigation Measure 4-2), 4.4.3.6.3 (Mitigation Measure 4-3), 4.4.3.6.4 (Mitigation Measure 4-4), 4.4.3.6.5 (Mitigation Measure 4-5). Because it is not known whether the mitigation measures listed above would reduce impacts to a less-than-significant level for Alternative 1A, these potential impacts are considered **significant and unavoidable**.

4.4.6 Alternative 1B

Under Alternative 1B, the construction and operation of surface water projects (water intakes, treatment and conveyance facilities, and reservoirs) would be the same as under the Proposed Project. As described in Section 2A, Proposed Project and Alternatives, there would be fewer groundwater projects (wells, wellhead treatment, conveyance facilities, recycled wastewater and stormwater projects (treatment and conveyance facilities), water transfers, and water use efficiency and conservation programs would be reduced relative to the Proposed Project. There would be no ocean desalination projects.

Projects to restore the Delta ecosystem would be reduced in extent relative to the Proposed Project and would not emphasize restoration of floodplains in the lower San Joaquin River. Implementation of flow objectives would not be accelerated or include Public Trust considerations. Stressor management activities and invasive species management (including removal of invasive vegetation) would be increased relative to the Proposed Project, but a variance to the USACE Levee Vegetation Policy would

not be pursued. In addition, Alternative 1B would not require conformance with the habitat types and elevation maps presented in the Conservation Strategy for the Restoration of the Sacramento-San Joaquin Delta Ecological Management Zone and the Sacramento and San Joaquin Valley Regions (DGF 2011e).

Flood risk reduction would place greater emphasis on levee modification/maintenance and dredging than under the Proposed Project, but there would be no setback levees or subsidence reversal projects. Floodplain expansion projects would be fewer or less extensive, as would reservoir reoperation. Actions to protect and enhance the Delta as an evolving place would be consistent with the Economic Sustainability Plan, but the locations for new parks, as encouraged by the Proposed Project, would not be emphasized.

4.4.6.1.1 Impact 4-1: Substantial Adverse Effects on Sensitive Natural Communities, Including Wetlands

Potential impacts on sensitive natural communities under Alternative 1B would be generally the same as those described for Alternative 1A, except that there could be more levee construction and dredging. In addition, a variance from the USACE Levee Vegetation Policy would not be pursued under Alternative 1B, which could result in greater impacts to riparian vegetation associated with levee modification and maintenance activities compared to the Proposed Project. By comparison to the Proposed Project, construction impacts associated with ecosystem restoration and flood risk reduction would be reduced because fewer projects would be constructed, but the potential benefits associated with these activities on sensitive natural communities, such as wetlands and riparian forest, would not be realized because of the reduced emphasis on ecosystem restoration and the development of new flow objectives that reflect a more natural flow regime.

In comparison to the Proposed Project, Alternative 1B would not require conformance with the habitat types and elevation maps presented in the Conservation Strategy for Restoration of the Sacramento-San Joaquin Delta Ecological Management Zone and the Sacramento and San Joaquin Valley Regions (DFG 2011a), which could reduce the amount of tidal marsh that would be restored. However, this could increase the opportunity to restore other terrestrial sensitive natural communities, such as riparian forest, within the area depicted by the map.

Overall, Alternative 1B would increase the potential for impacts on sensitive natural communities by delaying the development of new flow standards that could benefit riparian forest, reducing the extent of habitat restoration, and increasing the potential for riparian impacts associated with levee construction by not seeking a variance to the USACE Levee Vegetation Policy. Therefore, significant impacts on sensitive natural communities under Alternative 1B would be **greater than** under the Proposed Project.

Compared to existing conditions, the impacts on sensitive natural communities under Alternative 1B would be **significant**.

4.4.6.1.2 Impact 4-2: Substantial Adverse Effects on Special-status Species

Impacts on special-status species would be increased compared to the Proposed Project under Alternative 1B for the same reasons described above for sensitive natural communities. While construction impacts might be reduced because fewer water supply facilities and ecosystem restoration projects would be constructed, the long-term benefits that would accrue to special-status species from the more extensive ecosystem restoration under the Proposed Project would not occur. Specific stressor reduction actions encouraged under Alternative 1B (e.g., increasing bag limits for striped bass) may benefit some special-status species such as Chinook salmon, while compliance with the USACE Levee

Vegetation Policy, rather than seeking a variance, could result in greater impacts to special-status species associated with riparian vegetation, such as Swainson's hawk and valley elderberry longhorn beetle. In addition, increased emphasis on dredging under Alternative 1B could increase the potential for entrainment or direct injury of special status species (e.g., delta smelt) or adverse modification of their habitat.

Alternative 1B would contribute less to improving current conditions or arresting further ecosystem decline because it would not accelerate the development and implementation of flow objectives for the Delta or restore habitat to the same levels as the Proposed Project. On balance, the overall adverse impacts on special-status species resulting from Alternative 1B would be **greater than** those under the Proposed Project, even though temporary construction impacts could be less.

Compared to existing conditions, the impacts on special-status species under Alternative 1B would be **significant**.

4.4.6.1.3 Impact 4-3: Substantial Reduction of Fish or Wildlife Species Habitat

Impacts on fish and wildlife habitat would be the same as those described for sensitive natural communities in Section 4.4.6.1.1, above. However, because Alternative 1B would not require conformance with the ERP habitat types and elevation map, there might be more flexibility to restore or enhance other fish and wildlife habitats, such waterfowl habitat. However, on balance, significant impacts on fish and wildlife habitat under Alternative 1B would be **greater than** under the Proposed Project.

Compared to existing conditions, the impacts on fish and wildlife habitat under Alternative 1B would be **significant**.

4.4.6.1.4 Impact 4-4: Interfere Substantially with the Movement of Any Native Resident or Migratory Fish or Wildlife Species or with Established Native Resident or Migratory Wildlife Corridors

The reduction the number of groundwater projects, ocean desalination projects, recycled wastewater and stormwater projects, water transfers, and water use efficiency and conservation programs would reduce the potential for these activities and facilities to interfere with fish and wildlife movement. The impacts of these facilities on fish and wildlife movement would be localized and temporary if the impacts could be mitigated. The increased emphasis on levee modification/maintenance and dredging, however, could result in a greater potential to adversely interfere with fish and wildlife movement, especially in the absence of a variance to the USACE Levee Vegetation Policy. Modification and maintenance of levees that results in the loss of existing vegetation could substantially interfere with wildlife movement over the long term. In addition, increased dredging under Alternative 1B would have the potential to result in greater interference with the movement of aquatic species during operations.

Alternative 1B also would not accelerate the development and implementation of new flow objectives for the Delta, and it would reduce emphasis on floodplain restoration, which could translate to a smaller contribution to improving conditions for the movement and migration of aquatic species compared to the Proposed Project.

Overall, significant impacts on fish and wildlife movement under Alternative 1B would be **greater than** under the Proposed Project.

Compared to existing conditions, the impacts on fish and wildlife movement under Alternative 1B would be **significant**.

4.4.6.1.5 Impact 4-5: Conflict with Any Local Policies or Ordinances Protecting Biological Resources or the Provisions of an Adopted Habitat Conservation Plan, Natural Community Conservation Plan, or Other Approved Local, Regional, or State Habitat Protection Plan

The same type of conflicts with local policies and ordinances protecting biological resources, or with adopted local habitat protection plans would occur under Alternative 1B as described under the Proposed Project. The projects and actions under Alternative 1B have the potential to conflict with these policies, ordinances, and plans, but because there would be fewer projects constructed, these conflicts would be less likely.

Overall, significant impacts associated with conflicts with these policies, ordinances, and plans under Alternative 1B would be **less than** under the Proposed Project.

Compared to existing conditions, the impacts resulting from these conflicts with policies, ordinances, and plans under Alternative 1B would be **significant**.

4.4.6.2 Mitigation Measures

Mitigation measures for impacts associated with Alternative 1B would be the same as those described for the Proposed Project in Sections 4.4.3.6.1 (Mitigation Measure 4-1), 4.4.3.6.2 (Mitigation Measure 4-2), 4.4.3.6.3 (Mitigation Measure 4-3), 4.4.3.6.4 (Mitigation Measure 4-4), 4.4.3.6.5 (Mitigation Measure 4-5). Because it is not known whether the mitigation measures listed above would reduce impacts to a less-than-significant level for Alternative 1B, these potential impacts are considered **significant and unavoidable**.

4.4.7 Alternative 2

As described in Section 2A, Proposed Project and Alternatives, Alternative 2 would place greater emphasis on groundwater, ocean desalination, water transfers, water use efficiency and conservation, and recycled water projects and less emphasis on surface water projects. The surface storage reservoirs considered under the DWR Surface Water Storage Investigation would not be encouraged; instead, the surface storage in the Tulare Basin would be emphasized. Ecosystem restoration projects similar to, but less extensive than those encouraged by the Proposed Project, would be emphasized without the requirement to conform to the ERP habitat types and elevation map. Alternative 2 would emphasize the development of flow objectives that take into consideration updated flow criteria that support a more natural flow regime, water rights, and greater protection of Public Trust resources.

Actions to improve water quality would be similar to or greater than under the Proposed Project, especially the treatment of wastewater and agricultural runoff. Actions to reduce flood risk under Alternative 2 would emphasize floodplain expansion and reservoir reoperation rather than levee construction and modification. The stockpiling of rock and encouragement of subsidence reversal projects would be the same as the Proposed Project, as would actions to protect and enhance the Delta as an evolving place.

4.4.7.1.1 Impact 4-1: Substantial Adverse Effects on Sensitive Natural Communities, Including Wetlands

Actions to improve water supply reliability under Alternative 2 would result in the construction of facilities that have the potential to adversely affect sensitive natural communities. However, because of the Alternative 2 would not encourage surface storage at the locations considered by the DWR Surface Water Storage Investigation, the significant construction-related impacts on sensitive natural communities that could result from those projects would not occur. The creation of surface storage in the Tulare Basin, as emphasized under Alternative 2, would similarly inundate thousands of acres, but the area affected

(primarily farmland) would be less likely to support sensitive natural communities. The construction of the conveyance facilities necessary to support surface storage in the Tulare Basin, however, could increase the likelihood of encountering and adversely affecting a sensitive natural community.

Over the long term, ecosystem restoration actions under Alternative 2 could have the potential to support a greater diversity of terrestrial sensitive natural communities because of the flexibility provided by not requiring conformance to the ERP habitat types and elevation map, although fewer acres of habitat would be restored. In addition, greater emphasis on the adoption and implementation of flow objectives that include public trust considerations and reflect a more natural flow regime would likely provide greater benefits to the sensitive natural communities (e.g., riparian forest) relative to the Proposed Project.

Projects to improve water quality under Alternative 2 could result in additional emphasis on the treatment of agricultural runoff, but overall the impacts of water quality improvement activities on sensitive natural communities should be similar to those of the Proposed Project.

The reduction in levee construction, modification, and maintenance under Alternative 2 would reduce the potential to adversely affect riparian vegetation. In addition, an increase in efforts to expand floodplains as a method to reduce flood risk could benefit riparian forest and wetland communities.

On balance, Alternative 2 would likely contribute more to improving the Delta ecosystem than the Proposed Project because of the greater emphasis on developing and implementing flow objectives that that provide ecosystem benefits, including improvements to sensitive natural communities. Therefore, significant impacts on sensitive natural communities under Alternative 2 would be **less than** under the Proposed Project.

Compared to existing conditions, the impacts on sensitive natural communities under Alternative 2 would be **significant**.

4.4.7.1.2 Impact 4-2: Substantial Adverse Effects on Special-status Species

Impacts on special-status species resulting from water supply facility construction under Alternative 2 would be similar to the Proposed Project. Construction impacts resulting from ecosystem restoration projects would be reduced under Alternative 2 because fewer acres would be constructed. In addition, the encouragement of the adoption and implementation of flow objectives with a greater public trust focus and a more natural flow regime would likely result in greater benefits to special-status species than the Proposed Project. The emphasis on striking a balance of flow and habitat improvements could result in the retention of more agricultural and other terrestrial habitats, which could benefit a broader number of special-status species. Water transfers might increase compared to the Proposed Project, which could increase the potential for land fallowing and the temporary loss of habitat for special-status species associated with agriculture.

The potential impacts on special-status species associated with actions to improve water quality would be slightly greater than those of the Proposed Project because of the increased emphasis on the construction of wastewater recycling and agricultural runoff treatment. Operation of these facilities might improve conditions for special-status species if it results in an improvement in water quality in the Delta.

The reduction in levee construction, modification, and maintenance under Alternative 2 would reduce the potential to adversely affect riparian vegetation and the special-status species that it supports. In addition, an increase in efforts to expand floodplains as a method to reduce flood risk could provide additional benefit to special-status species (e.g., Sacramento splittail) that use flooded areas relative to the Proposed Project. Similarly, a reduction in dredging under Alternative 2 could reduce impacts on special-status species.

On balance, the temporary construction-related impacts under Alternative 2 would be greater than the Proposed Project because fewer projects would be constructed. In addition, the increased emphasis that Alternative 2 places on environmentally beneficial flows would likely contribute more to improving conditions for special-status species and arresting their decline. Therefore, significant impacts on special-status species under Alternative 2 would be **less than** under the Proposed Project.

Compared to existing conditions, the impacts on special-status species under Alternative 2 would be **significant**.

4.4.7.1.3 Impact 4-3: Substantial Reduction of Fish or Wildlife Species Habitat

Impacts on fish and wildlife habitat under Alternative 2 would be the same as those described for sensitive natural communities in Section 4.4.7.1.1, above. The development of a large surface water storage facility in the Tulare Lake Basin would adversely impact the fish and wildlife habitat that would be inundated by the project. This would be similar to the effects of storage projects considered under the DWR Surface Water Storage Investigation, except that the lands influenced would be primarily farmland. Surface storage at this location could provide greater habitat benefits for waterbirds because of its location relative to the Pacific Flyway.

By comparison to the Proposed Project, the emphasis on new flow objectives that support environmental uses could lead to reductions in the amount of water exported from the Delta and possible increases in the permanent retirement or fallowing of agricultural lands that serve as wildlife habitat outside the Delta. This also could reduce the riparian vegetation established along agricultural conveyance channels if these channels would be dewatered.

On balance, Alternative 2 would have a greater impact on habitat for agricultural species than the Proposed Project, but the overall significant impacts on fish and wildlife habitat under Alternative 2 would be **less than** under the Proposed Project because Alternative 2 would contribute more to improving habitat for fish and wildlife.

Compared to existing conditions, the impacts on fish and wildlife habitat under Alternative 2 would be **significant**.

4.4.7.1.4 Impact 4-4: Interfere Substantially with the Movement of Any Native Resident or Migratory Fish or Wildlife Species or with Established Native Resident or Migratory Wildlife Corridors

Under Alternative 2, the emphasis on water supply reliability projects would differ from the Proposed Project, but the impacts of these facilities on fish and wildlife movement would be similar. Surface storage in Tulare Basin could result in fewer impacts to local wildlife movement than the reservoir locations considered under the Proposed Project because of its location in agricultural land. Once inundated, this location might provide greater benefits to birds migrating along the Pacific Flyway.

Impacts associated with the construction of ecosystem restoration would be reduced relative to the Proposed Project because fewer acres would be restored. The greater emphasis on new flow objectives that support a more natural flow regime and increased protection of public trust resources could improve migration for anadromous fish, such as salmon and sturgeon, compared to the Proposed Project.

The reduction in levee construction, modification, and maintenance under Alternative 2 would reduce the potential to adversely affect riparian corridors used by migrating wildlife.

Overall, significant impacts on fish and wildlife movement under Alternative 2 would be **less than** under the Proposed Project because of the greater emphasis on flow objectives to achieve environmental benefits and a reduction in construction impacts associated with levees and dredging.

Compared to existing conditions, the impacts on fish and wildlife movement under Alternative 2 would be **significant**.

4.4.7.1.5 Impact 4-5: Conflict with Any Local Policies or Ordinances Protecting Biological Resources or the Provisions of an Adopted Habitat Conservation Plan, Natural Community Conservation Plan, or Other Approved Local, Regional, or State Habitat Protection Plan

The same types of conflicts with local policies and ordinances protecting biological resources, or with adopted local habitat protection plans as described under the Proposed Project would occur under Alternative 2. The projects and actions under Alternative 2 have the potential to conflict with these policies, ordinances, and plans, but because there would be fewer projects constructed, these conflicts would be less likely.

Overall, significant impacts associated with conflicts with these policies, ordinances, and plans under Alternative 2 would be **less than** under the Proposed Project.

Compared to existing conditions, the impacts resulting from these conflicts with policies, ordinances, and plans under Alternative 2 would be **significant**.

4.4.7.2 Mitigation Measures

Mitigation measures for impacts associated with Alternative 2 would be the same as those described for the Proposed Project in Sections 4.4.3.6.1 (Mitigation Measure 4-1), 4.4.3.6.2 (Mitigation Measure 4-2), 4.4.3.6.3 (Mitigation Measure 4-3), 4.4.3.6.4 (Mitigation Measure 4-4), 4.4.3.6.5 (Mitigation Measure 4-5). Because it is not known whether the mitigation measures listed above would reduce impacts to a less-than-significant level for Alternative 2, these potential impacts are considered **significant and unavoidable**.

4.4.8 Alternative 3

As described in Section 2A, Proposed Project and Alternatives, the water supply reliability projects and actions under Alternative 3 would be similar to those of the Proposed Project, although there would less emphasis on surface water projects. Ecosystem restoration (floodplain restoration, riparian restoration, tidal marsh restoration, and floodplain expansion) would be reduced relative to the Proposed Project and restoration on publically owned lands, especially in Suisun Marsh and the Yolo Bypass, would be emphasized. There would be more stressor management actions (e.g., programs for water quality, water flows) and more management for nonnative invasive species. Water quality improvements would be the same as the Proposed Project. Actions under Alternative 3 to reduce flood risk would not include setback levees or subsidence reversal, but would result in greater levee modification/maintenance and dredging relative to the Proposed Project. Reservoir reoperation and materials stockpiling would be the same as the Proposed Project, as would activities to protect and enhance the Delta as an evolving place.

4.4.8.1.1 Impact 4-1: Substantial Adverse Effects on Sensitive Natural Communities, Including Wetlands

The impacts resulting from water supply reliability projects on sensitive natural communities under Alternative 3 would be similar to those that would result from the Proposed Project, except that impacts associated with surface water projects under this alternative would be fewer because the reduced number of facilities constructed. Construction impacts associated with ecosystem restoration would be less than under the Proposed Project because restoration would be reduced and focused on public land. While the impacts of restoration construction would be reduced relative Proposed Project, so would the potential benefits to sensitive natural communities that would result from ecosystem restoration. Alternative 3

would not encourage floodplain restoration in the lower San Joaquin, and would do less to improve conditions for riparian habitat than the Proposed Project.

The greater emphasis on levee modification/maintenance and dredging under Alternative 3 would increase the potential for impacts to riparian vegetation, especially if a variance to the USACE Levee Vegetation Policy would not be obtained. Reduced emphasis on floodplain expansion could reduce the construction-related impacts on sensitive natural communities, but potential long-term benefits to sensitive natural communities resulting from floodplain expansion would not be realized.

Overall, significant impacts on sensitive natural communities under Alternative 3 would be **greater than** under the Proposed Project because of the emphasis on levee modification/maintenance and dredging activities that could impact riparian communities.

Compared to existing conditions, the impacts on sensitive natural communities under Alternative 3 would be **significant**.

4.4.8.1.2 Impact 4-2: Substantial Adverse Effects on Special-status Species

Under Alternative 3, temporary construction-related impacts on special-status species resulting from projects to improve water supply reliability might be less than the Proposed Project because fewer water supply projects would be constructed. This would reduce the potential for impact compared the Proposed Project. Construction impacts associated with ecosystem restoration would be similar to the Proposed Project but reduced because there would be less extensive restoration activity under Alternative 3. The impacts on special-status species resulting from construction of projects and actions to improve water quality would be the same as the Proposed Project.

The reduced emphasis on floodplain expansion under Alternative 3 could reduce construction-related impacts on special-status species, but potential long-term benefits to special-status species resulting from floodplain expansion would not be realized. In addition, the greater emphasis on levee modification and maintenance under Alternative 3 would increase the potential for long-term impacts to riparian vegetation, especially if a variance to the USACE Levee Vegetation Policy would not be obtained. Changes in riparian vegetation could translate into long-term impacts on special-status species that inhabit riparian forest.

The increase in stressor management under Alternative 3 could result in an improvement in conditions for certain special-status species, depending on which stressors would be addressed. Overall, Alternative 3 would contribute less than the Proposed Project to improving habitat conditions for special-status species and arresting their decline because less habitat would be restored. In addition, construction impacts of levee modification and dredging would increase under Alternative 3. Therefore, the significant impacts on special-status species under Alternative 3 would be **greater than** under the Proposed Project, even though there might be fewer construction impacts and a reduction in the effects of stressors.

Compared to existing conditions, the impacts on special-status species under Alternative 3 would be **significant**.

4.4.8.1.3 Impact 4-3: Substantial Reduction of Fish or Wildlife Species Habitat

The mechanism for impacts on fish and wildlife habitat under Alternative 3 would be the same as those described for sensitive natural communities in Section 4.4.8.1.1, above. The physical loss of habitat within facility footprints under Alternative 3 also could be less than the Proposed Project because fewer facilities would be constructed. However, the impacts of levee modification and dredging on fish and wildlife habitat would be increased compared to the Proposed Project, and the benefits of habitat restoration would be reduced.

On balance, significant impacts on fish and wildlife habitat under Alternative 3 would be about the **same as** under the Proposed Project because fewer acres of agricultural habitat would be converted to other habitat types.

Compared to existing conditions, the impacts on fish and wildlife habitat under Alternative 3 would be **significant**.

4.4.8.1.4 Impact 4-4: Interfere Substantially with the Movement of Any Native Resident or Migratory Fish or Wildlife Species or with Established Native Resident or Migratory Wildlife Corridors

Under Alternative 3, impacts on fish and wildlife movement would be similar to the Proposed Project, except that there would fewer impacts resulting from water supply projects because there would be fewer water supply projects constructed. Similarly, impacts associated with the construction of ecosystem restoration would be reduced relative to the Proposed Project because fewer acres would be restored. However, the benefits of ecosystem restoration on fish and wildlife movement would be diminished relative to the Proposed Project.

The greater emphasis on levee modification and maintenance under Alternative 3 would increase the potential for impacts to riparian vegetation, especially if a variance to the USACE Levee Vegetation Policy would not be obtained. Changes in riparian vegetation could translate into interference with the movement of native fish and wildlife. In addition, the increased emphasis on dredging could result in a greater likelihood of substantial interference with the movement of aquatic species.

The reduced emphasis on floodplain expansion under Alternative 3 could reduce construction-related impacts on fish and wildlife movement, but potential long-term improvements in wildlife corridors resulting from floodplain expansion would not be realized.

Overall, significant impacts on fish and wildlife movement under Alternative 3 would be **greater than** under the Proposed Project because of the emphasis on levee modification/maintenance and dredging activities and the reduction in habitat restoration.

Compared to existing conditions, the impacts on fish and wildlife movement under Alternative 3 would be **significant**.

4.4.8.1.5 Impact 4-5: Conflict with Any Local Policies or Ordinances Protecting Biological Resources or the Provisions of an Adopted Habitat Conservation Plan, Natural Community Conservation Plan, or Other Approved Local, Regional, or State Habitat Protection Plan

The same types of conflicts with local policies and ordinances protecting biological resources, or with adopted local habitat protection plans as described under the Proposed Project would occur under Alternative 3. However, the potential for conflicts could be reduced if Alternative 3 results in fewer projects being constructed.

Overall, significant impacts associated with conflicts with these policies, ordinances, and plans under Alternative 3 would be **less than** under the Proposed Project.

Compared to existing conditions, the impacts resulting from these conflicts with policies, ordinances, and plans under Alternative 3 would be **significant**.

4.4.8.2 Mitigation Measures

Mitigation measures for impacts associated with Alternative 3 would be the same as those described for the Proposed Project in Sections 4.4.3.6.1 (Mitigation Measure 4-1), 4.4.3.6.2 (Mitigation Measure 4-2), 4.4.3.6.3 (Mitigation Measure 4-3), 4.4.3.6.4 (Mitigation Measure 4-4), 4.4.3.6.5 (Mitigation

Measure 4-5). Because it is not known whether the mitigation measures listed above would reduce impacts to a less-than-significant level for Alternative 3, these potential impacts are considered **significant and unavoidable**.

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Attachments to Section 4
Biological Resources Tables

Table 4-1
Special-status Plant Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Common Name Scientific Name	Legal Status			Habitat	Distribution in California	Flowering Period	Potential for Occurrence
	Federal[a]	State[b]	CRPR[c]				
Bent flowered fiddleneck *Amsinckia lunaris*	–	–	1B.2	Found in coastal bluff scrub, cismontane woodland, and valley and foothill grassland; 0- to 1,600-foot elevation	Alameda, Contra Costa, Colusa, Lake, Marin, Napa, San Benito, Santa Clara, Santa Cruz, San Mateo, and Yolo counties	March–June	Could occur; suitable habitat is present, and species is known from the vicinity
Ferris' milk-vetch Astragalus tener var. ferrisiae	–	–	1B.1	Vernally mesic meadows and mildly alkaline flats in valley and foothill grassland, usually on dry, heavy clay or adobe soil; 0- to 2,500-foot elevation	Western edge of the Central Valley from Butte to Solano counties	April–May	Could occur; suitable habitat is present, and species is known from the vicinity
Alkali milk-vetch *Astragalus tener* var. *tener*	–	–	1B.2	Alkaline vernal pools and playas, and valley and foothill grassland with alkaline adobe clay soils; 3- to 2,000-foot elevation	Central Valley and eastern San Francisco Bay Area	March–June	Known to occur in the Delta and Suisun Marsh
Heartscale *Atriplex cordulata*	–	–	1B.2	Sandy, saline, or alkaline flats or scalds, in chenopod scrub, meadows, and valley and foothill grassland	Central Valley, from Kern County in the south to Butte and Glenn counties in the north, and from Alameda County, Contra Costa, and Solano counties in the west to Madera and Tulare counties in the east; believed to be extirpated from San Joaquin, Stanislaus, and Yolo counties and has not been reported from Sacramento County	April–October	Known to occur in the Delta and Suisun Marsh
Crownscale *Atriplex coronata* var. *coronata*	–	–	4.2	Alkaline soils in vernal pools, valley foothill grassland, and chenopod scrub	Central Valley, the foothills of the Sierra Nevada, and the inner south coast 4anges	March–October	Known to occur in the Delta and Suisun Marsh

Table 4-1
Special-status Plant Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Common Name Scientific Name	Legal Status			Habitat	Distribution in California	Flowering Period	Potential for Occurrence
	Federal[a]	State[b]	CRPR[c]				
Brittlescale *Atriplex depressa*	–	–	1B.2	Alkaline clay soils in chenopod scrub, meadows and seeps, playas, valley and foothill grassland, or vernal pools; 3- to 1,050-foot elevation	Central Valley and Tulare Basin	May–October	Known to occur in the Delta and Suisun Marsh
San Joaquin spearscale *Atriplex joaquiniana*	–	–	1B.2	Alkaline soils in chenopod scrub, meadows and seeps, playas, and valley and foothill grassland; 3- to 2,750-foot elevation	Western edge of the Central Valley from Glenn County to Tulare County	April–October	Known to occur in the Delta and Suisun Marsh
Lesser saltscale *Atriplex minuscula*	–	–	1B.1	Alkaline sandy soils in chenopod scrub, playas, valley and foothill grassland; 45- to 600-foot elevation	Central Valley from Kern County to Stanislaus County and in Alameda and Butte counties	May–October	Could occur; suitable habitat is present, and species is known from the vicinity
Vernal pool smallscale *Atriplex persistens*	–	–	1B.2	Alkaline vernal pools; 30- to 400-foot elevation	Scattered locations throughout the Central Valley from Glenn County to Tulare County	June–October	Could occur; suitable habitat is present, and species is known from the vicinity
Big tarplant *Blepharizonia plumosa*	–	–	1B.1	Valley and foothill grassland; 100- to 1,600-foot elevation	Scattered locations throughout the inner Coast Ranges from Solano County to Stanislaus County	July–October	Could occur; suitable habitat is present, and species is known from the vicinity
Watershield *Brasenia schreberi*	–	–	2.3	Freshwater marshes and swamps	North Coast Ranges, Cascade Range, Sierra Nevada, and Central Valley	June–September	Unlikely to occur; presumed extirpated in the Delta and other known populations are found at higher elevations
Brewer's calandrinia *Calandrinia breweri*	–	–	4.2	Sandy or loamy soils on disturbed sites; burns in chaparral and coastal scrub; 30- to 4,000-foot elevation	Widely scattered locations from Shasta County to San Diego County, but always uncommon; many collections are old	March–June	Could occur; suitable habitat is present, and species is known from the vicinity

Table 4-1
Special-status Plant Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Common Name Scientific Name	Legal Status			Habitat	Distribution in California	Flowering Period	Potential for Occurrence
	Federal[a]	State[b]	CRPR[c]				
Mt. Diablo fairy-lantern *Calochortus pulchellus*	–	–	1B.2	Openings in chaparral, coastal scrub, and associated grasslands; 100- to 2,800-foot elevation	Inner Coast Ranges in Alameda, Contra Costa, and Solano counties	April–June	Unlikely to occur; where found in the vicinity, it grows at higher elevations
Bristly sedge *Carex comosa*	–	–	2.1	Coastal prairie, marshes and swamps, valley and foothill grassland, on lake margins, and wet places; 0- to 2,100-foot elevation	Fairly widely distributed in California ranging from Shasta County to San Bernardino County	May–September	Known to occur in the Delta
Fox sedge *Carex vulpinoidea*	–	–	2.2	Freshwater marshes, swamps, and riparian woodland; 100- to 4,000-foot elevation	Butte, Kern, Los Angeles, Shasta, Siskiyou, San Joaquin, Tehama, and Trinity counties	May–June	Known to occur in the Delta
Johnny-nip *Castilleja ambigua* ssp. *ambigua*	–	–	4.2	Coastal bluff scrub, coastal prairie, coastal scrub, marshes and swamps, valley and foothill grassland, vernal pool margins	Coastal counties from San Luis Obispo to Del Norte, Napa, Contra Costa, and Alameda counties	March–August	Could occur; suitable habitat is present and species is known from the vicinity
Congdon's tarplant *Centromadia parryi* ssp. *congdonii*	–	–	1B.2	Alkaline, often heavy clay soils in mesic areas within grassland communities with ruderal and native alkali-tolerant plants; 0- to 600-foot elevation	Alameda, Contra Costa, Monterey, Santa Clara, Santa Cruz, San Luis Obispo, San Mateo, and Solano counties	June–November	Could occur; suitable habitat is present, and species is known from the vicinity
Pappose tarplant *Centromadia parryi* ssp. *parryi*	–	–	1B.2	Mesic areas in coastal prairie, meadow, and grassland habitats, often on alkaline substrates; 0- to 1,400-foot elevation	Butte, Colusa, Glenn, Lake, Napa, San Mateo, Solano, and Sonoma counties	June–November	Could occur; suitable habitat is present, and species is known from the vicinity

Table 4-1
Special-status Plant Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Common Name Scientific Name	Legal Status			Habitat	Distribution in California	Flowering Period	Potential for Occurrence
	Federal[a]	State[b]	CRPR[c]				
Pappose tarplant *Centromadia parryi* ssp. *rudis*	–	–	4.2	Mesic areas in coastal prairie, meadow, and grassland habitats, often on alkaline substrates; 0- to 300-foot elevation	Butte, Colusa, Glenn, Lake, Merced, Sacramento, San Joaquin, Solano, Sutter, and Yolo counties	June–November	Could occur; suitable habitat is present, and species is known from the vicinity
Bolander's water hemlock *Cicuta maculata* var. *bolanderi*	–	–	2.1	Coastal, fresh, or brackish marshes; 0- to 600-foot elevation	Contra Costa, Los Angeles, Marin, Sacramento, Santa Barbara, San Luis Obispo, and Solano counties	July–September	Known to occur in the Delta and Suisun Marsh
Slough thistle *Cirsium crassicaule*	–	–	1B.1	Chenopod scrub habitat or along sloughs in marshes, and swamps and riparian scrub habitat; 0- to 300-foot elevation	Kings, Kern, and San Joaquin counties	May–August	Known to occur in the Delta
Suisun thistle *Cirsium hydrophilum* var. *hydrophilum*	E	–	1B.1	Salt and brackish marshes; 0- to 3-foot elevation	Restricted to the Suisun Marsh in Solano County	June–September	Known to occur in Suisun Marsh
Small flowered morning glory *Convolvulus simulans*	–	–	4.2	Serpentine seeps in valley and foothill grassland; openings in chaparral and coastal scrub; 100- to 2,100-foot elevation	Fairly widely distributed in California, ranging from Contra Costa County to San Diego County	March–July	Could occur; suitable habitat is present, and species is known from the vicinity
Hispid bird's-beak *Cordylanthus mollis* ssp. *hispidus*	–	–	1B.1	Mesic alkaline soils in meadows and seeps, playas, and valley and foothill grassland; 3- to 500-foot elevation	Scattered locations in San Joaquin Valley from Solano County to Kern County	June–September	Could occur; suitable habitat is present, and species is known from the vicinity
Soft bird's-beak *Cordylanthus mollis* ssp. *mollis*	E	R	1B.2	Coastal salt marshes and swamps; 0- to 10-foot elevation	Endemic to the San Pablo Bay and Suisun Bay area; may have historically occurred in the Delta	July–September	Could occur; suitable habitat is present, and species is known from the vicinity

Table 4-1
Special-status Plant Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Common Name Scientific Name	Legal Status			Habitat	Distribution in California	Flowering Period	Potential for Occurrence
	Federal[a]	State[b]	CRPR[c]				
Palmate-bracted bird's-beak *Cordylanthus palmatus*	E	E	1B.1	Alkaline soils in chenopod scrub and valley and foothill grassland; 15- to 500-foot elevation	Glenn, Colusa, Yolo, Alameda, Madera, and Fresno counties	May–October	Could occur; suitable habitat is present, and species is known from the vicinity
Hoover's cryptantha *Cryptantha hooveri*	–	–	1A	Inland dunes and sandy soils in valley and foothill grassland; 30- to 500-foot elevation	Contra Costa, Merced, Stanislaus, Madera, and Kern counties	April–May	Unlikely; although there is a historical record from the city of Antioch, this species is presumed extinct by CNPS
Recurved larkspur *Delphinium recurvatum*	–	–	1B.2	Alkaline soils in cismontane woodland and valley and foothill grassland; 10- to 2,500-foot elevation	Central Valley and foothills from Contra Costa County to Kern County	March–June	Known to occur in the Delta
Dwarf downingia *Downingia pusilla*	–	–	2.2	Vernally mesic sites in valley and foothill grassland and vernal pools; 3- to 1,500-foot elevation	Central Valley from Tehama County to Fresno County	March–May	Known to occur in the Delta and Suisun Marsh
Small spikerush *Eleocharis parvula*	–	–	4.3	Marshes and swamp; 0- to 10,000-foot elevation	Distributed in 14 counties in California from Siskiyou County to Orange County	June–August	Could occur; suitable habitat is present
Antioch Dunes buckwheat *Eriogonum nudum* var. *psychichola*	–	–	1B.1	Inland dunes; 0- to 60-foot elevation	Contra Costa County	July–October	Known to occur; known from single occurrence in Antioch Dunes, but species may also be present in other areas where conditions are favorable
Mt. Diablo buckwheat *Eriogonum truncatum*	–	–	1B.1	Sandy soils in chaparral, coastal scrub, and valley and foothill grasslands; 10- to 1,050-foot elevation	Alameda, Contra Costa, and Solano counties	April–December	Unlikely to occur; presumed extinct but rediscovered in Mt. Diablo State Park, the only known extant occurrence

Table 4-1
Special-status Plant Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Common Name Scientific Name	Legal Status			Habitat	Distribution in California	Flowering Period	Potential for Occurrence
	Federal[a]	State[b]	CRPR[c]				
Round-leaved filaree *Erodium macrophyllum*	–	–	1B.1	Clay soils in cismontane woodland and valley and foothill grassland; 50- to 4,000-foot elevation	Distributed in 25 counties in California from Humboldt County to San Diego County	March–May	Could occur; suitable habitat is present, and species is known from the vicinity
Delta button-celery *Eryngium racemosum*	–	E	1B.1	Vernally mesic clay depressions in riparian scrub habitat; 10- to 100-foot elevation	Delta and floodplains	June–September	Known to occur in the Delta
Contra Costa wallflower *Erysimum capitatum* ssp. *angustatum*	E	E	1B.1	Inland dunes, generally on stabilized dunes of sand and clay near Antioch along the San Joaquin River; 0- to 70-foot elevation	Documented occurrences restricted to near Antioch Dunes National Wildlife Refuge	March–July	Known to occur in the Delta
Diamond-petaled California poppy *Eschscholzia rhombipetala*	–	–	1B.1	Alkaline and clay soils in valley and foothill grassland; 0- to 1,000-foot elevation	Rediscovered on Carrizo Plain in San Luis Obispo County by David Keil in 1992; not seen there since 1995; also found at Lawrence Livermore Laboratory in Alameda County 1997, where extant as of 2003; historical occurrences known from San Joaquin, Stanislaus, and Colusa counties	March–April	Could occur; suitable habitat is present, and species is known from the vicinity
Stinkbells *Fritillaria agrestis*	–	–	4.2	Chaparral, cismontane woodland, pinyon and juniper woodland, and valley and foothill grasslands; often found on clay soils, sometimes serpentinite soils; 30- to 5,000-foot elevation	Distributed in 20 counties in California from Mendocino County to Ventura County	March–June	Could occur; suitable habitat is present, and species is known from the vicinity

Table 4-1
Special-status Plant Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Common Name Scientific Name	Legal Status			Habitat	Distribution in California	Flowering Period	Potential for Occurrence
	Federal[a]	State[b]	CRPR[c]				
Fragrant fritillary *Fritillaria liliacea*	–	–	1B.2	Heavy clay soils (often with a serpentine influence) in cismontane woodland, coastal prairie, coastal scrub, and valley and foothill grassland	Found in all counties surrounding the San Francisco Bay region except for Napa County	February–April	Could occur; suitable habitat is present, and species is known from the vicinity
Bogg's Lake hedge-hyssop *Gratiola heterosepala*	–	E	1B.2	Lake margin marshes and swamps and vernal pools in clay soils; 30- to 7,800-foot elevation	Fresno, Lake, Lassen, Madera, Merced, Modoc, Placer, Sacramento, Shasta, Siskiyou, San Joaquin, Solano, and Tehama counties	April–August	Could occur; suitable habitat is present, and species is known from the vicinity
Hogwallow starfish *Hesperevax caulescens*	–	–	4.2	Shallow vernal pools and mesic, clay soils in valley and foothill grassland; 0- to 1,500-foot elevation	Widespread in the Central Valley and south coast ranges from Tehama County to Kern County	March–June	Could occur; suitable habitat is present, and species is known from the vicinity
Brewer's western flax *Hesperolinon breweri*	–	–	1B.2	Rocky, serpentine soils in chaparral, cismontane woodland, and valley and foothill grassland; 100- to 3,000-foot elevation	Found only in the inner Coast Ranges of Contra Costa, Napa, and Solano counties	May–July	Unlikely to occur; plant is found primarily on serpentine soils that do not occur in the Delta
Rose-mallow *Hibiscus lasiocarpos* var. *occidentalis*	–	–	1B.2	Freshwater marshes and swamps; generally found on wetted riverbanks and low peat islands in sloughs; 0- to 100-foot elevation	Central Valley from Butte County to San Joaquin County	June–September	Known to occur in the Delta and Suisun Marsh
Central coast iris *Iris longipetala*	–	–	4.2	Grows in mesic coastal prairie, lower montane coniferous forest, and meadows and seeps; 0- to 2,000-foot elevation	Coast Ranges from Humboldt County to Monterey County	March–May	Unlikely to occur; many collections are old and need field surveys to verify; may hybridize with *Iris missouriensis*

Table 4-1
Special-status Plant Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Common Name Scientific Name	Legal Status			Habitat	Distribution in California	Flowering Period	Potential for Occurrence
	Federal[a]	State[b]	CRPR[c]				
Carquinez goldenbush *Isocoma arguta*	–	–	1B.1	Grows in alkaline soils on flats and low hills in valley and foothill grassland; often occurs on low benches near drainages and on mounds in swale areas	Solano County	August–December	Could occur; suitable habitat is present, and species is known from the vicinity.
Contra Costa goldfields *Lasthenia conjugens*	E	–	1B.1	Grows in vernal pools, swales, and other depressions in open grassland and woodland communities, often in alkaline soils	Alameda, Contra Costa, Mendocino, Monterey, Marin, Napa, Santa Barbara, Santa Clara, Solano, and Sonoma counties	March–June	Could occur; suitable habitat is present, and species is known from the vicinity
Ferris' goldfields *Lasthenia ferrisiae*	–	–	4.2	Alkaline and claypan vernal pools; 60- to 2,300-foot elevation	Distributed in 18 counties from Butte County to Ventura County	February–May	Could occur; suitable habitat is present, and species is known from the vicinity
Delta tule pea *Lathyrus jepsonii* var. *jepsonii*	–	–	1B.2	Freshwater and brackish marshes at sea level	Restricted to the Delta	May–September	Known to occur in the Delta and Suisun Marsh
Legenere *Legenere limosa*	–	–	1B.1	Bottoms of vernal pools and other wet depressions in grassland communities	Central Valley and north Coast Ranges from Shasta County to Santa Clara County	April–June	Known to occur in the Delta and Suisun Marsh
Heckard's peppergrass *Lepidium latipes* var. *heckardii*	–	–	1B.2	Alkaline flats and in alkaline grasslands along the edges of vernal pools	Glenn, Solano, and Yolo counties	March–May	Known to occur in the Delta
Mason's lilaeopsis *Lilaeopsis masonii*	–	R	1B.1	Freshwater and brackish marshes, riparian scrub, generally found in tidal zones, on depositional soils; 0- to 30-foot elevation	Restricted to the Delta	April–November	Known to occur in the Delta and Suisun Marsh

Table 4-1
Special-status Plant Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Common Name Scientific Name	Legal Status			Habitat	Distribution in California	Flowering Period	Potential for Occurrence
	Federal[a]	State[b]	CRPR[c]				
Delta mudwort *Limosella subulata*	–	–	2.1	Riparian scrub, freshwater marsh, brackish marsh, generally on mud banks of the Delta in marshy or scrubby riparian; 0- to 10-foot elevation	Restricted to the Delta	May–August	Known to occur in the Delta and Suisun Marsh
Showy madia *Madia radiata*	–	–	1B.1	Grows in cismontane woodland and valley and foothill grassland; 75- to 2,700-foot elevation	Scattered locations in the Coast Ranges from Contra Costa County to Ventura County; most collections are old and need field verification	March–May	Could occur; suitable habitat is present, and species is known from the vicinity
Little mousetail *Myosurus minimus* ssp. *apus*	–	–	3.1	Alkaline vernal pools and other wetland habitats in valley and foothill grassland and coastal sage scrub; 65- to 2,100-foot elevation	Scattered locations in the northern Sacramento Valley and inner north Coast Ranges, San Francisco Bay area, San Joaquin Valley from Stanislaus County to Tulare County, southern coast and southern Coast Ranges, Peninsular and Transverse ranges, and the Mohave Desert	March–June	Could occur; suitable habitat is present, and species is known from the vicinity
Cotulaleaf pincushionplant *Navarretia cotulifolia*	–	–	4.2	Adobe clay soils in chaparral, cismontane woodland, and valley and foothill grassland; 0- to 6,000-foot elevation	Distributed in 16 counties in Northern California from Mendocino County to San Benito County (possibly in Siskiyou County)	May–June	Could occur; suitable habitat is present, and species is known from the vicinity

Table 4-1
Special-status Plant Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Common Name Scientific Name	Legal Status			Habitat	Distribution in California	Flowering Period	Potential for Occurrence
	Federal[a]	State[b]	CRPR[c]				
Baker's navarretia *Navarretia leucocephala* ssp. *bakeri*	–	–	1B.1	Vernal pools and other wet depressions in cismontane woodland, lower montane coniferous forest, meadows, and valley and foothill grassland, in adobe or alkaline soils; 0- to 5,500-foot elevation	Colusa, Glenn, Lake, Mendocino, Marin, Napa, Solano, Sonoma, Sutter, Tehama, and Yolo counties	May–July	Could occur; suitable habitat is present, and species is known from the vicinity
Colusa grass *Neostapfia colusana*	T	E	1B.1	Large vernal pools with adobe clay soils; 15- to 4,000-foot elevation	Merced, Solano, Stanislaus, and Yolo counties	May–August	Could occur; suitable habitat is present, and species is known from the vicinity
Antioch Dunes evening primrose *Oenothera deltoides* ssp. *howellii*	E	E	1B.1	Inland dunes, remnant river bluffs, and sand dunes east of Antioch, along river bluffs, and in loose sand; 0- to 100-foot in elevation	Known from three native occurrences in Contra Costa and Sacramento counties	March–September	Known to occur in the Delta
Gairdner's yampah *Perideridia gairdneri* ssp. *gairdneri*	–	–	4.2	Vernal pools and vernally mesic areas in broadleafed upland forest, chaparral, coastal prairie, and valley and foothill grasslands; 0- to 1,200-foot elevation	Distributed throughout the northern and southern Coast Ranges from Mendocino County to San Diego County; status of many occurrences is unknown	June–October	Could occur; suitable habitat is present, and species is known from the vicinity
Hairless popcorn flower *Plagiobothrys glaber*	–	–	1A	Coastal salt marsh and alkaline meadows and seeps	Historical occurrences are all located in the San Francisco Bay region; the last confirmed sighting was in 1954; possibly relocated near Antioch, but the identification of this collection is uncertain	March–May	Could occur; suitable habitat is present

Table 4-1
Special-status Plant Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Common Name Scientific Name	Legal Status			Habitat	Distribution in California	Flowering Period	Potential for Occurrence
	Federal[a]	State[b]	CRPR[c]				
Bearded popcorn-flower *Plagiobothrys hystriculus*	–	–	1B.1	Habitat and life history not well understood; probably grows in vernal pools or wet sites in grasslands	Known from only a few occurrences in the Montezuma Hills region of Solano County	April–May	Could occur; suitable habitat is present, and species was rediscovered in 2000 just outside of the Suisun Marsh in the Montezuma Hills
Eel-grass pondweed *Potamogeton zosteriformis*	–	–	2.2	Marshes and swamps; 0- to 6,000-foot elevation	Contra Costa, Lake, Lassen, Modoc, and Shasta counties	June–July	Known to occur in the Delta
Delta woolly marbles *Psilocarphus brevissimus* var. *multiflorus*	–	–	4.2	Vernal pools; 0- to 1,500-foot elevation	Alameda, Napa, Santa Clara, San Diego, San Joaquin, Solano, Stanislaus, and Yolo counties	May–June	Could occur; suitable habitat is present, and species is known from the vicinity
Lobb's aquatic buttercup *Ranunculus lobbii*	–	–	4.2	Vernal pools in cismontane woodland, north coast coniferous forest, and valley and foothill grassland; 50- to 1,550-foot elevation	Alameda, Contra Costa, Mendocino, Marin, Napa, Santa Cruz, San Mateo, Solano, and Sonoma counties	February–May	Could occur; suitable habitat is present, and species is known from the vicinity
Sanford's arrowhead *Sagittaria sanfordii*	–	–	1B.2	Assorted shallow freshwater marshes and swamps; 0- to 2,000-foot elevation	Butte, Del Norte, Fresno, Kern, Merced, Orange, Sacramento, Shasta, San Joaquin, Tehama, and Ventura counties	May–October	Known to occur in the Delta
Marsh skullcap *Scutellaria galericulata*	–	–	2.2	Lower montane coniferous forest, meadows and seeps, marshes and swamps, wet places; 0- to 7,000-foot elevation	El Dorado, Lassen, Modoc, Nevada, Placer, Plumas, Shasta, Siskiyou, and San Joaquin counties	June–September	Could occur; suitable habitat is present, and species is known from the vicinity
Side-flowering skullcap *Scutellaria lateriflora*	–	–	2.2	Marshes and swamps, meadows and seeps; 0- to 1,500-foot elevation	Known in California from only three occurrences in Inyo, Sacramento, and San Joaquin counties	July–September	Known to occur in the Delta

Table 4-1
Special-status Plant Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Common Name Scientific Name	Legal Status			Habitat	Distribution in California	Flowering Period	Potential for Occurrence
	Federal[a]	State[b]	CRPR[c]				
Suisun Marsh aster *Symphyotrichum lentum*	–	–	1B.2	Marshes and swamps, often along sloughs; 0- to 10-foot elevation	Endemic to the Delta	May–November	Known to occur in the Delta and Suisun Marsh
Wright's trichocoronis *Trichocoronis wrightii* var. *wrightii*	–	–	2.1	Alkaline soils of marshes and swamps, meadows and seeps, riparian forest, and vernal pools, usually on mud flats; 15- to 1,500-foot elevation	Central Valley and south coast	May–September	Known to occur in the Delta and Suisun Marsh
Saline clover *Trifolium depauperatum* var. *hydrophilum*	–	–	1B.2	Salt marshes and in alkaline soils in moist valley and foothill grasslands and vernal pools; 0- to 1,000-foot elevation	Alameda, Colusa, Monterey, Napa, San Benito, Santa Clara, Santa Cruz, San Luis Obispo, San Mateo, Solano, and Sonoma counties	April–June	Known to occur in the Delta and Suisun Marsh
Caper-fruited tropidocarpum *Tropidocarpum capparideum*	–	–	1B.1	Mesic alkaline soils in valley and foothill grassland, vernal pools; 160- to 1,300-foot elevation	Scattered locations in the Central Valley and central West Coast	March–April	Could occur; suitable habitat is present, and species is known from the vicinity
Solano grass Tuctoria mucronata	E	E	1B.1	Alkaline/saline clay bottoms of vernal pools, lakes, and shallow playa pools; associated with other vernal pool and wetland plants, including the endangered Colusa grass (*Neostapfia colusana*)	Known from only three occurrences in Solano County	April–July	Could occur; suitable habitat is present, and species is known from the vicinity

Table 4-1
Special-status Plant Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Sources: CNDDB 2011; CNPS 2011

[a] **U.S. Fish and Wildlife Service—Federal Listing Categories:**

T: Threatened.

E: Endangered.

–: No status.

[b] **California Department of Fish and Game—State Listing Categories:**

R: Rare.

E: Endangered.

–: No status.

[c] **California Rare Plant Rank:**

1A: Presumed extinct.

1B: Plants rare, threatened, or endangered in California and elsewhere.

2: Plants rare, threatened, or endangered in California, but more common elsewhere.

3: Plants for which more information is needed—a review list.

4: Plants of limited distribution—a watch list.

Extensions:

1: Seriously endangered in California (>80 percent of occurrences are threatened and/or high degree and immediacy of threat).

2: Fairly endangered in California (20–80 percent of occurrences are threatened).

3: Not very endangered in California (<20 percentof occurrences are threatened or no current threats are known).

CNPS:California Native Plant Society

CRPR: California Rare Plant Rank

Delta: Sacramento–San Joaquin Delta.

Table 4-2
Special-status Fish and Wildlife Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Common Name	Scientific Name	Legal Status		Other Status[c]	Habitat	Range and Potential to Occur
		Federal[a]	State[b]			
Invertebrates						
Blennosperma vernal pool andrenid bee	*Andrena blennospermatis*	–	–	G2 S2	Upland areas near vernal pools	Occurs in central California between Lake and San Joaquin counties; known from locations east and west of the Delta; could occur in vernal pool grasslands in the Delta
Antioch dunes anthicid beetle	*Anthicus antiochensis*	–	–	G1 S1	Loose sand on sand bars and sand dunes	Likely extinct in Antioch Dunes; also known from Grand Island and southern Sacramento County; could occur in dune habitat in the Delta
Sacramento anthicid beetle	*Anthicus sacramento*	–	–	G1 S1	Sandslip faces in willows; associated with riparian and other aquatic habitat	On Sacramento and lower San Joaquin rivers and tributaries from Butte County to San Joaquin County; could occur in sandy riparian habitat in the Delta
Lange's metalmark butterfly	*Apodemia mormo langei*	E	–	–	Stabilized sand dunes along the San Joaquin River; endemic to the Antioch Dunes; host plant is nude buckwheat	Distribution limited to Antioch Dunes, in Contra Costa County
Conservancy fairy shrimp	*Branchinecta conservatio*	E	–	–	Vernal pools and swales	Occurs from Butte and Tehama counties to Ventura County; could occur in vernal pools in the Delta
Longhorn fairy shrimp	*Branchinecta longiantenna*	E	–	–	Small, shallow vernal pools and swales in alkali soils or rock outcrops	Occurs from Contra Costa County south to San Luis Obispo County; could occur in small, shallow pools associated with alkali soils in the Delta
Vernal pool fairy shrimp	*Branchinecta lynchi*	T	–	–	Vernal pools and other seasonal wetlands	Occurs in the Central Valley from Shasta County to Tulare County and the central and southern Coast Ranges from northern Solano County to Ventura County; known to occur in vernal pools near the eastern Delta and Clifton Court Forebay and north and east of the Suisun Marsh; could occur in vernal pools elsewhere in the Delta
Midvalley fairy shrimp	*Branchinecta mesovallensis*	–	–	G2 S2	Vernal pools	Occurs in Central Valley from Sacramento and Solano counties south to Fresno County; could occur in vernal pools in the Delta
Sacramento Valley tiger beetle	*Cicindela hirticollis abrupta*	–	–	G5 T SH	Required fine to medium sand, terraced floodplains or low sandy water edge flats	Presumed extinct; therefore, unlikely to occur in the Delta

Table 4-2
Special-status Fish and Wildlife Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Common Name	Scientific Name	Legal Status		Other Status[c]	Habitat	Range and Potential to Occur
		Federal[a]	State[b]			
San Joaquin Dune beetle	*Coelus gracilis*	–	–	G1 S1	Fossil dunes in western San Joaquin Valley	Occurred historically from Kings County north to Antioch Dunes; presumed extirpated from Antioch Dunes; unlikely to occur in the Delta because of lack of fossil dune habitat
Monarch butterfly	*Danaus plexippus*	–	–	G5 S3	Wind-protected tree groves with nearby nectar and water sources	One historic (1976) occurrence from the city of Fairfield; could occur in groves in the western Delta
Valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*	T	–	–	Elderberry shrubs, typically in riparian habitats	Central Valley, including the Delta, below approximately 3,000-foot elevation; could occur throughout the Delta
Hairy water flea	*Dumontia oregonensis*	–	–	G1G3 S1	Described in 2003 from a specimen taken from a vernal pool in southern Oregon; little is known about its natural history; subsequently detected in vernal pools located in Mather Field and Travis Air Force Base in California	Known to occur in a vernal pool less than 1 mile outside the Delta; could occur in vernal pools throughout the Delta
Antioch efferian robberfly	*Efferia antiochi*	–	–	G1G3 S1S3	None known; robberfly larvae usually develop in the ground or in rotting wood, where they prey on other insect larvae	Antioch, Fresno, and Scout Island (in the San Joaquin River); the Delta is within the range of this species, but lack of specific habitat use limits an assessment of the potential for this species to occur
Redheaded sphecid wasp	*Eucerceris ruficeps*	–	–	G1G3 S1S2	Interior dunes	Western Central Valley from Contra Costa County to Fresno County; could occur in the Delta
Bridges' Coast Range shoulderband	*Helminthoglypta nickliniana bridgesi*	–	–	G2 TH S1	Open hillsides in grasses and weeds	Central and western Contra Costa and Alameda counties; unlikely to occur in the Delta and Suisun Marsh
Ricksecker's water scavenger beetle	*Hydrochara ricksecker*i	–	–	G1G2 S1S2	Ponds; little is known about specifics of habitat associations	Recorded in central coastal California and southern Sacramento Valley; known from Cosumnes River Preserve; could occur in the Delta

Table 4-2
Special-status Fish and Wildlife Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Common Name	Scientific Name	Legal Status		Other Status[c]	Habitat	Range and Potential to Occur
		Federal[a]	State[b]			
Curved-foot Hygrotus diving beetle	*Hygrotus curvipes*	–	–	G1 S1	Small seasonal pools; associated with alkaline plant communities	East Contra Costa and Alameda counties; could occur in the southern part of the Delta, in Contra Costa County
Middlekauff's shieldback katydid	*Idiostatus middlekauffi*	–	–	G1G2 S1	Interior dunes	Known only from Antioch Dunes; could occur in dune habitat in the Delta
Vernal pool tadpole shrimp	*Lepidurus packardi*	E	–	–	Vernal pools, swales, and other ephemeral wetlands	Northern, central, and portions of Southern California; could occur in the Delta and is known to occur in vernal pools near the Stone Lakes National Wildlife Refuge
California linderiella	*Linderiella occidentalis*	–	–	G3 S2S3	Vernal pools, swales, and other ephemeral wetlands	Central Valley and central coastal California; could occur in the Delta and is known to occur in vernal pools near the Stone Lakes National Wildlife Refuge
Molestan blister beetle	*Lytta molesta*	–	–	G2 S2	Often associated with dried vernal pools	Central California; known to occur in the southernmost portion of the Delta, in eastern Contra Costa County; could occur elsewhere in vernal pools near the Stone Lakes National Wildlife Refuge
Hurd's metapogon robberfly	*Metapogon hurdi*	–	–	G1G3 S1S3	Sand dunes	Antioch Dunes and dunes near Fresno; could occur in the Delta but unlikely
Antioch multilid wasp	*Myrmosula pacifica*	–	–	GH SH	Unknown	Presumed extinct; therefore, unlikely to occur in the Delta and Suisun Marsh
Antioch adrenid bee	*Perdita scitula antiochensis*	–	–	G1 T1 S1	Interior sand dunes	Currently known only from Antioch Dunes; formerly occurred in Oakley; unlikely to occur in the Delta and Suisun Marsh
Antioch specid wasp	*Philanthus nasalis*	–	–	G1 S1	Sand dunes and sand hills	Extirpated from Antioch Dunes, extant in sand hills in Santa Cruz County; unlikely to occur in the Delta and Suisun Marsh
Antioch Dunes halcitid bee	*Sphecodogastra antiochensis*	–	–	G1 S1	Restricted to Antioch Dunes; host plant is *Oenothera deltoids howellii*	Distribution limited to Antioch Dunes, in Contra Costa County

Table 4-2
Special-status Fish and Wildlife Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Common Name	Scientific Name	Legal Status		Other Status[c]	Habitat	Range and Potential to Occur
		Federal[a]	State[b]			
Amphibians						
California tiger salamander	*Ambystoma californiense*	T	T	–	In winter, breeds in vernal pools and seasonal wetlands with a minimum 10-week inundation period; in summer, aestivates in grassland habitat, primarily in rodent burrows	Occurs from Yolo County to Kern County in the Central Valley and up to 2,000-foot elevation in the Sierra Nevada foothills, and from Sonoma County to Santa Barbara County on the coast; known to occur in the southernmost portion of the Delta near Clifton Court Forebay and in the western portion north of Suisun Bay in the Potrero Hills; could occur elsewhere in vernal pools
California red-legged frog	*Rana draytonii*	T	SSC	–	Foothill streams with dense shrubby or emergent riparian vegetation, minimum 11-20 weeks of water for larval development, and upland refugia for aestivation	Occurs primarily in the foothills of the central Coast Ranges, with isolated populations in the Sierra Nevada; a few individuals have been documented in the southernmost portion of the Delta near Clifton Court Forebay; unlikely to occur in most areas because it has been extirpated from most of the Delta and valley floor
Western spadefoot	*Spea hammondii*	–	SSC	–	In winter, breeds in vernal pools and seasonal wetlands with a minimum 3-week inundation period; in summer, aestivates in grassland habitat, in soil crevices and rodent burrows	Range includes the Central Valley and southern Coast Ranges and foothills; could occur in vernal pools in the southern portion of the Delta near Clifton Court Forebay and in the northern portion near Stone Lake
Reptiles						
Western pond turtle	*Actinemys marmorata*	–	SSC	–	Forages in ponds, marshes, slow-moving streams, sloughs, and irrigation ditches; nests in nearby uplands with low, sparse vegetation	Range spans across California west of the Sierra-Cascade crest, below 5,000 feet in elevation; documented throughout the Delta and Suisun Marsh, except along the Sacramento Deep Water Ship Channel
Silvery legless lizard	*Anniella pulchra pulchra*	–	SSC	–	Associated with a variety of vegetation types on sandy soils with accessible moisture, primarily but not exclusively in semistabilized dunes	Patchily distributed from Antioch south along the coast, foothills, San Joaquin Valley, and southern Sierra Nevada; could occur in dunes and tailings in several locations in the Delta

Table 4-2
Special-status Fish and Wildlife Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Common Name	Scientific Name	Legal Status		Other Status[c]	Habitat	Range and Potential to Occur
		Federal[a]	State[b]			
San Joaquin whipsnake	*Masticophis flagellum ruddocki*	–	SSC	–	Open habitats—grasslands, savannas, deserts, open-canopy scrub, chaparral, and pastures—with available rodent burrows for cover	Ranges across the San Joaquin Valley and associated foothills to the west; could occur in southern upland portion of the Delta
Coast horned lizard	*Phrynosoma blainvilli*	–	SSC	–	Variety of open habitats, including chaparral, oak savanna, and grassland; found primarily in areas with sandy, friable soils, scattered shrubs, and abundant ant colonies	Range includes most of west-central and southwestern California below 8,000-foot elevation, including the entire Delta; could occur in stabilized dunes and the grasslands near Clifton Court Forebay and north of Stone Lake
Giant garter snake	*Thamnophis gigas*	T	T	–	Forages in slow-moving streams, sloughs, ponds, marshes, inundated floodplains, rice fields, and irrigation and drainage canals; also requires upland refugia not subject to flooding during the snake's inactive season	Range spans the southern Sacramento and northern San Joaquin valleys; documented in several locations throughout the Delta
Fish						
Green sturgeon (Southern DPS)	*Acipenser medirostris*	T	SSC	–	Coastal marine waters as subadults and adults; adults and subadults also occupy estuarine waters and larger rivers; spawning takes place in large rivers	The only known spawning population for the Southern DPS is in the Sacramento River. Adults and subadults occupy the San Francisco Bay, San Pablo Bay, Suisun Bay, and the Delta adjacent to the Sacramento River.
Delta smelt	*Hypomesus transpacificus*	T	E	–	Bays and estuaries; adults migrate into low salinity or freshwater reaches of the San Francisco estuary (primarily the Delta) to spawn	Delta smelt are endemic to the Bay-Delta estuary. The geographic distribution of delta smelt is primarily downstream of Isleton on the Sacramento River, downstream of Mossdale on the San Joaquin River, and Suisun Bay and Suisun Marsh. Delta smelt have also been collected in the Petaluma and Napa rivers.

Table 4-2
Special-status Fish and Wildlife Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Common Name	Scientific Name	Legal Status		Other Status[c]	Habitat	Range and Potential to Occur
		Federal[a]	State[b]			
Steelhead Central Valley DPS	*Oncorhynchus mykiss irideus*	T	–	–	Cold clear streams with a boulder, cobble, or gravel substrate; from low to high elevations with low to relatively high stream gradients for spawning; fry and juveniles rear along stream margins before migrating through estuaries on their way to the Pacific Ocean	Existing wild steelhead stocks in the Central Valley are mostly confined to the upper Sacramento River and its tributaries, including Antelope, Deer, and Mill creeks and the Yuba River. A few wild steelhead are produced in the American and Feather rivers Small self-sustaining populations of steelhead are found in the Stanislaus, Mokelumne, and Calaveras rivers.
Winter-run Chinook salmon Sacramento River ESU	*Oncorhynchus tshawytscha*	E	E	–	Cold clear streams with a boulder, cobble, or gravel substrate; generally in low elevation reaches with relatively low stream gradients for spawning; fry and juveniles rear along stream margins before migrating through estuaries on their way to the Pacific Ocean	Naturally spawning populations of winter-run Chinook salmon currently are restricted to accessible reaches of the upper Sacramento River and tributaries such as Battle Creek. Fry and juveniles use the Delta, Suisun Marsh, and the Yolo Bypass for rearing to varying degrees.
Spring-run Chinook salmon Central Valley ESU	*Oncorhynchus tshawytscha*	T	T	–	Cold clear streams with a boulder, cobble, or gravel substrate; from low to high elevations with low to relatively high stream gradients for spawning; fry and juveniles rear along stream margins before migrating through estuaries on their way to the Pacific Ocean	Naturally spawning populations of spring-run Chinook salmon currently are restricted to accessible reaches of the upper Sacramento River and tributaries such as Antelope, Battle, Beegum, Big Chico, Butte, Clear, Deer, and Mill creeks; and the Feather and Yuba rivers. Fry and juveniles use the Delta, Suisun Marsh, and the Yolo Bypass for rearing to varying degrees.
Fall/late fall-run Chinook salmon Central Valley ESU	*Oncorhynchus tshawytscha*	FSC	SSC	–	Cold clear streams with a boulder, cobble, or gravel substrate; generally in low elevation reaches with relatively low stream gradients for spawning; fry and juveniles rear along stream margins before migrating through estuaries on their way to the Pacific Ocean	Fall/late fall-run Chinook salmon are known to spawn in the Sacramento River and tributaries, eastside tributaries to the Delta and tributaries of the San Joaquin River. Fry and juveniles use the Delta, Suisun Marsh, and the Yolo Bypass for rearing to varying degrees.

Table 4-2
Special-status Fish and Wildlife Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Common Name	Scientific Name	Legal Status		Other Status[c]	Habitat	Range and Potential to Occur
		Federal[a]	State[b]			
Longfin smelt	*Spirinchus thaleichthys*	–	T	–	Bays, estuaries and nearshore coastal waters; adults migrate into low salinity or freshwater reaches of coastal rivers and tributary streams to spawn	In California, longfin smelt are known from the Klamath River, Humboldt Bay and its tributaries, the Eel River, the Van Duzen River, the Russian River, and the San Francisco Bay-Delta. Longfin smelt use the entire estuary from the freshwater Sacramento-San Joaquin Delta downstream to South San Francisco Bay and out into coastal marine waters.
River lamprey	*Lampetra ayresii*	–	SSC	–	Clean, gravelly riffles in permanent streams are used for spawning; ammocoetes rear in high quality, perennial backwaters or stream edges over a sandy substrate, into which they bury in the sediments; adults are oceanic	The river lamprey is found from near Alaska to the San Francisco Bay. The species is more abundant in the lower Sacramento-San Joaquin River system than in other streams in California, but few surveys for river lamprey have been conducted.
Hardhead	*Mylopharodon conocephalus*	–	SSC	–	Low to mid-elevation streams in the Sacramento and San Joaquin drainages; gravel beds in riffles, runs, or the heads of pools are used for spawning; rearing takes place along stream edges in dense cover provided by flooded vegetation or tree branches	Widely distributed in low to mid-elevation streams in the Sacramento and San Joaquin drainages. In the Sacramento River drainage, hardhead are present in the Sacramento River and most larger tributary streams. In the San Joaquin drainage, hardhead are found scattered in various tributary streams, but are largely absent from the valley reaches of the mainstem San Joaquin River.
Sacramento splittail	*Pogonichthys macrolepidotus*	–	SSC	–	Sloughs, lakes, and rivers of the Central Valley; non-reproductive splittail are abundant in shallow, brackish tidal sloughs	Sacramento splittail is endemic to the sloughs, lakes, and rivers of the Central Valley. In the Sacramento River basin, the most important spawning areas appear to be the Yolo and Sutter bypasses, which are extensively flooded during wet years. In the San Joaquin drainage, spawning apparently takes place in wet years where the San Joaquin River is joined by the Tuolumne and Merced rivers.

Table 4-2
Special-status Fish and Wildlife Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Common Name	Scientific Name	Legal Status		Other Status[c]	Habitat	Range and Potential to Occur
		Federal[a]	State[b]			
Birds						
Cooper's hawk	*Accipiter cooperii*	–	WL (nesting)	–	Nests and forages primarily in riparian woodlands and other wooded habitats	Year-round range spans most of the wooded portions of California; could occur throughout the Delta and Suisun Marsh where patches of suitable wooded habitat are present but likely in low numbers
Tricolored blackbird	*Agelaius tricolor*	BCC	SSC (nesting)	–	Nests colonially in large, dense stands of freshwater marsh, riparian scrub, and other shrubs and herbs; forages in grasslands and agricultural fields	Ranges primarily throughout the Central Valley and the central and southern coasts, with additional scattered locations throughout California; year-round resident; could occur throughout the Delta and Suisun Marsh
Grasshopper sparrow	*Ammodramus savannarum*	–	SSC (nesting)	–	Nests and forages in dense grasslands; favors a mix of native grasses, forbs, and scattered shrubs	Breeding range spans much of the Central Valley and California coast, but populations are typically localized and disjunct; most individuals migrate, although some may be present year-round; known to occur in the Yolo Bypass Wildlife Area and the northeast and southeast portions of the Delta; may occur in other portions of the Delta and Suisun Marsh
Tule greater white-fronted goose	*Anser albifrons elgasi*	–	SSC (wintering)	–	Forages primarily in marshes dominated by tules, bulrushes, and cattails; forages to a lesser extent in rice and other grain fields	Does not breed in California; wintering populations are concentrated primarily in Sacramento Valley wildlife refuges and surrounding rice fields; the Suisun Marsh, uplands in Grizzly Island Wildlife Area, and nearby duck clubs; and marginally the Napa Marshes; occurs primarily west of the Delta
Golden eagle	*Aquila chrysaetos*	BCC	FP, WL	–	Nests and forages in a variety of open habitats, including grassland, shrubland, and cropland; most common in foothill habitats; rare foothill breeder; nests in cliffs, rock outcrops, and large trees	Winter range spans most of California; breeding range excludes the Central Valley floor; not expected to nest in the Delta and Suisun Marsh; nonbreeding individuals may forage throughout the area's uplands; most likely to occur in the scrub and grasslands of the southern portion near Clifton Court Forebay

Table 4-2
Special-status Fish and Wildlife Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Common Name	Scientific Name	Legal Status		Other Status[c]	Habitat	Range and Potential to Occur
		Federal[a]	State[b]			
Great egret	*Ardea alba*	–	CFGC (rookeries)	–	Nests colonially in tall trees; forages in freshwater and saline marshes, shallow open water, and occasionally cropland or low, open upland habitats, such as pastures	Year-round range spans the Central Valley, central coast, and portions of Southern California; winter range expands to include the remainder of the coast; may nest and forage throughout the Delta and Suisun Marsh; rookeries have been documented throughout the Delta, especially on protected lands and instream islands
Great blue heron	*Ardea herodias*	–	CFGC (rookeries)	–	Nests colonially in tall trees; forages in freshwater and saline marshes, shallow open water, and occasionally cropland or low, open upland habitats, such as pastures	Year-round range spans most of California except the eastern portion of the state and the highest elevations; winter range expands to include eastern California; nests and forages throughout the Delta and Suisun Marsh, especially on protected lands and instream islands
Short-eared owl	*Asio flammeus*	–	SSC (nesting)	–	Nests on the ground among herbaceous vegetation, such as grasses or cattails; forages in grasslands, agricultural fields, and marshes	Breeding range is patchily distributed throughout the state and Delta, including portions of the Sacramento and San Joaquin valleys, northeastern California, and a few scattered coastal sites; Grizzly Island in the Suisun Marsh supports the only known breeding population in the planning area, although small numbers have been documented episodically at the Cosumnes River Preserve and in Byron in Contra Costa County
Burrowing owl	*Athene cunicularia hypugea*	BCC	SSC (nesting)	–	Nests and forages in grasslands, agricultural fields, and low scrub habitats, especially where ground squirrel burrows are present; occasionally inhabits artificial structures and small patches of disturbed habitat	Year-round range includes the Central Valley and Delta and portions of the central coast, eastern California, and Southern California; may occur throughout the Delta and Suisun Marsh where habitat is suitable; documented on Brannan Island and near Suisun Bay and Clifton Court Forebay

Table 4-2
Special-status Fish and Wildlife Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Common Name	Scientific Name	Legal Status		Other Status[c]	Habitat	Range and Potential to Occur
		Federal[a]	State[b]			
Redhead	*Aythya americana*	–	SSC (nesting)	–	Nests in freshwater emergent wetlands with dense patches of tules or cattails interspersed with open water more than 3 feet deep; forages by diving in deep open water	Year-round range is patchily distributed through portions of the Central Valley, northeastern California, and Southern California; not expected to nest in the Delta and Suisun Marsh, although a low potential exists at freshwater duck clubs that maintain summer water at depths greater than 3 feet with suitable surrounding marsh; known to nest in the Yolo Bypass, but no recent nesting records occur elsewhere in the Delta and Suisun Marsh
Ferruginous hawk	*Buteo regalis*	–	WL	–	Forages most commonly in grasslands and shrublands; also forages in agricultural fields	Winter range spans most of California except the higher elevations of the Sierra Nevada and northern Coast Ranges; does not nest in California; may forage in winter throughout the uplands of the Delta and Suisun Marsh; most likely to occur in the scrub and grasslands of the southern portion near Clifton Court Forebay
Swainson's hawk	*Buteo swainsoni*	BCC	ST (nesting)	–	Nests in isolated trees, open woodlands, and woodland margins; forages in grasslands and agricultural fields	Breeding range spans the Central Valley and Delta west of the Suisun Marsh, northeastern California, and a few additional scattered sites; most of the population migrates south of California in fall, although a small number winters in the Delta
Western snowy plover	*Charadrius alexandrinus nivosus*	T	SSC	–	Nests and forages on sandy and gravelly beaches along the coast and the shores of inland alkali lakes	Breeds in coastal California and near alkali lakes in eastern California and remnant alkali playas in the southern San Joaquin Valley; not expected to occur in the Delta or Suisun Marsh because these areas are outside of the species' known range; nesting has been documented in three Yolo County sites: the Yolo Bypass, Davis Sewage Ponds, and Woodland Sugar Ponds; no other recent records exist for the Delta or Sacramento Valley
Mountain plover	*Charadrius montanus*	BCC	SSC (wintering)	–	Forages in short grasslands and plowed agricultural fields where vegetation is sparse and trees are absent	Winter range spans the western Central Valley, including areas of the Delta east of the Suisun Marsh, and portions of Southern California; does not breed in California; may occur throughout the Delta and Suisun Marsh where habitat is suitable

Table 4-2
Special-status Fish and Wildlife Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Common Name	Scientific Name	Legal Status		Other Status[c]	Habitat	Range and Potential to Occur
		Federal[a]	State[b]			
Northern harrier	*Circus cyaneus*	–	SSC (nesting)	–	Nests on the ground among herbaceous vegetation, such as grasses or cattails; forages in grasslands, agricultural fields, and marshes	Breeding range encompasses much of lowland California; winter range expands to include the remaining lowland areas; may nest and forage throughout the Delta and Suisun Marsh; nesting has been documented in the eastern portion of the Suisun Marsh and near Clifton Court Forebay
Western yellow-billed cuckoo	*Coccyzus americanus occidentalis*	C	E	–	Nests in valley, foothill, and desert riparian forest with densely foliaged deciduous trees and shrubs, especially willows; other associated vegetation includes cottonwood trees, blackberry, nettle, and wild grape	Historically common but now a rare summer resident at isolated sites in Sacramento Valley in Northern California and along Kern and Colorado River systems in Southern California; occasionally documented in Colusa, Glenn, Butte, Sutter, and Yolo counties within the last 20 years
Yellow warbler	*Dendroica petechia brewsteri*	–	SSC (nesting)	–	Nests and forages in early successional riparian habitats	Range includes coastal and Northern California and the Sierra Nevada below approximately 7,000 feet; mostly extirpated from the southern Sacramento and San Joaquin valleys; has recently been documented (1998–2002) in limited locations in the Delta during the breeding season
Snowy egret	*Egretta thula*	–	CFGC (rookeries)	–	Nests colonially in dense marshes and low trees; forages in freshwater and saline marshes, shallow open water, and occasionally irrigated cropland or wet upland habitats	Year-round range spans the Central Valley, Delta, entire coast, central Coast Ranges, and southeastern California; winter range expands to include northeastern California; may nest and forage throughout the Delta and Suisun Marsh, especially on protected lands near marshes
White-tailed Kite	*Elanus leucurus*	–	FP	–	Forages in ponds, marshes, slow-moving streams, sloughs, and irrigation ditches; nests in nearby uplands with low, sparse vegetation	Year-round range spans the Central Valley, Coast Ranges and coast, Sierra Nevada foothills, and Colorado River; may nest and forage throughout the Delta and Suisun Marsh; documented in the Delta along the Sacramento River west of Stone Lake, and in the north-central and east-central Delta

Table 4-2
Special-status Fish and Wildlife Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Common Name	Scientific Name	Legal Status		Other Status[c]	Habitat	Range and Potential to Occur
		Federal[a]	State[b]			
California horned lark	*Eremophila alpestris actia*	–	WL	–	Nests and forages in open habitats with sparse vegetation, including grasslands and fallow agricultural fields	Year-round range spans most of lowland California; may nest and forage in the Delta and Suisun Marsh where habitat is suitable, particularly in the grasslands and alkali sink habitat in the southern portion near Clifton Court Forebay
Merlin	*Falco columbarius*	–	WL (wintering)	–	Forages in a wide variety of habitats, but in the Central Valley is most common around agricultural fields and grasslands	Winter range encompasses most of California except the highest elevations; does not breed in California; may forage in winter throughout the Delta and Suisun Marsh
Prairie falcon	*Falco mexicanus*	BCC	WL (nesting)	–	Forages most commonly in grasslands and low shrublands; also forages in agricultural fields	Year-round range includes eastern California, the Coast Ranges, and much of Southern California; winter range expands to include the Delta, Central Valley, and coast; low probability of nesting in the Delta and Suisun Marsh, with a higher likelihood of foraging in suitable habitats during postbreeding dispersal, migration, or winter; most likely to occur in the Delta in the southernmost portion near Clifton Court Forebay; known to nest near Byron in Contra Costa County, although this area is not generally included in the published breeding range
American peregrine falcon	*Falco peregrinus anatum*	BCC	FP, E (nesting)	–	Forages in a wide variety of habitats, but is most common near water, where shorebirds and waterfowl are abundant	Year-round range includes the Sierra Nevada, Cascade Range, northeastern California, Coast Ranges, and coast; winter range expands to include the Central Valley and the Delta and additional portions of eastern and Southern California; not expected to nest in the Delta because these areas are outside of the published breeding range; may forage in winter throughout these areas

Table 4-2
Special-status Fish and Wildlife Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Common Name	Scientific Name	Legal Status		Other Status[c]	Habitat	Range and Potential to Occur
		Federal[a]	State[b]			
Saltmarsh common yellowthroat	*Geothlypis trichas sinuosa*	BCC	SSC	–	Primarily brackish marsh with dense and continuous wetland or riparian vegetation down to the water surface; however, to a lesser degree, also uses woody swamp and freshwater marsh; often found in rush, tall grass, and willow-dominated communities	Endemic to the greater San Francisco Bay Area with boundaries being Santa Clara County to the south, Carquinez Straight to the east, the Napa Marsh in southern Sonoma County to the north, and western Marin County to the west. CNDDB also documents several occurrences, some nesting, in the Suisun Marsh; however, subspecies identification may be suspect (Gardali and Evens 2008)
Lesser sandhill crane	*Grus canadensis canadensis*	–	SSC (wintering)	–	Forages primarily in croplands with waste grain; also frequents grasslands and emergent wetlands	Winter range is concentrated in scattered patches in the Delta, northern Sacramento Valley, portions of the San Joaquin Valley (especially in Merced County), Carrizo Plain, and Southern California south of the Salton Sea; occurs more widely between these areas during migration; does not breed in California; may forage during winter throughout the Delta
Greater sandhill crane	*Grus canadensis tabida*	–	T, FP	–	Forages primarily in croplands with waste grain; also frequents grasslands and emergent wetlands	Winter range includes the Central Valley and Delta, Carrizo Plain, Southern California south of the Salton Sea, and Colorado River; breeds in northeastern California; may forage during winter throughout the Delta
Bald eagle	*Haliaeetus leucocephalus leucocephalus*	–	E, FP	–	Forages primarily in large inland fish-bearing waters with adjacent large trees or snags, and occasionally in uplands with abundant rabbits, other small mammals, or carrion	Breeding range includes the Sierra Nevada, Cascade Range, and portions of the Coast Ranges; winter range expands to include most of the state except southeastern California (although the species occurs along the Colorado River); not expected to nest in the Delta and Suisun Marsh; in winter, may forage in the Delta along large rivers and in areas managed for waterfowl
Yellow-breasted chat	*Icteria virens*	–	SSC	–	Nests and forages in riparian thickets of willow and other brushy tangles near water and thick understory in riparian woodland	Breeding range includes the northern Sacramento Valley, Cascade Range, Sierra Nevada foothills, northwestern California, most of the Coast Ranges, the Colorado River, and other scattered sites, including part of the Delta; migrates south of California in fall; nests in patches of the Delta where habitat is suitable

Table 4-2
Special-status Fish and Wildlife Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Common Name	Scientific Name	Legal Status		Other Status[c]	Habitat	Range and Potential to Occur
		Federal[a]	State[b]			
Least bittern	*Ixobrychus exilis*	–	SSC (nesting)	–	Nests and forages in cattail and bulrush marshes	Current breeding range is scattered in patches of the Sacramento and San Joaquin valleys, Clear Lake, marshes around several large lakes in eastern California, and portions of Southern California, where they also winter; known to occur on Joice Island in the Suisun Marsh; low probability of occurrence in other portions of the Delta, particularly the marshes in the southeast and central Delta, and potentially in private duck clubs; a few individuals have been documented in the Yolo Bypass, Freeport in Sacramento County, and Palm Tract in Contra Costa County, but the Delta is no longer a major population center for the species
Loggerhead shrike	*Lanius ludovicianus*	BCC	SSC (nesting)	–	Nests in isolated shrubs and trees and woodland edges of open habitats; forages in grasslands, agricultural fields, and low scrub habitats	Breeding range spans much of lowland California, and winter range includes most lowland areas south of Glenn County. May occur throughout the Delta and Suisun Marsh, especially in the Clifton Court Forebay area
California black rail	*Laterallus jamaicensis coturniculus*	BCC	ST, FP	–	Nests and forages in saline, freshwater, or brackish emergent marshes with gently grading slopes and upland refugia with vegetative cover beyond the high-water line	Year-round range includes the Suisun Marsh, San Pablo Bay, Morro Bay, a few patches in the Sierra Nevada foothills, and portions of Southern California; winter range expands to include San Francisco Bay and the Marin County coast; several historic nesting occurrences documented in the southern half of the Delta
Song sparrow "Modesto" population	*Melospiza melodia*	–	SSC	–	Nests and forages primarily in emergent marsh, riparian scrub, and early successional riparian forest habitats, and infrequently in mature riparian forest and sparsely vegetated ditches and levees	Year-round range includes the Delta east of the Suisun Marsh, the Sacramento Valley, and the northern San Joaquin Valley; known to forage in the Delta, along Threemile Slough; nests and forages throughout the Delta
Suisun song sparrow	*Melospiza melodia maxillaris*	BCC	SSC	–	Nests and forages in brackish water marshes dominated by cattails, tules, and pickleweed	Year-round range includes the marshes surrounding Suisun Bay, from the confluence of the Sacramento and San Joaquin rivers to the Carquinez Strait; not expected in the remainder of the Delta

Table 4-2
Special-status Fish and Wildlife Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Common Name	Scientific Name	Legal Status		Other Status[c]	Habitat	Range and Potential to Occur
		Federal[a]	State[b]			
San Pablo song sparrow	*Melospiza melodia samuelis*	–	SSC	–	Coastal salt marshes dominated by pickleweed; nests in gumplant bordering slough channels	Year-round range includes the marshes surrounding San Pablo Bay and northern San Francisco Bay; unlikely to occur in the Delta and Suisun Marsh
Osprey	*Pandion haliaetus*	–	WL	–	Forages exclusively in fish-bearing waters; nests in nearby trees or tall, constructed platforms	Breeding range includes most of Northern California, the central Coast Ranges, and the southern Sierra Nevada; winter range also includes the central coast and additional portions of Southern California; nests in the Delta and could forage throughout the Delta and Suisun Marsh in winter
California brown pelican	*Pelecanus occidentalis californicus*	–	FP	–	Nests colonially on small to moderate sized coastal islands, just outside surf line, building nests with sticks on the ground	Usually found on the coast; may occur in the Delta near deeper water where it can forage
Double-crested cormorant	*Phalacrocorax auritus*	–	WL (rookeries)	–	Forages in open water; breeds colonially in rock ledges and trees	Breeding range spans the Delta, the coast and offshore islands, Clear Lake, the Salton Sea, the Colorado River, and portions of northeastern California; winter range expands to include the Central Valley and additional portions of Southern California; may nest and forage throughout the Delta and Suisun Marsh; a rookery has been documented in the Delta, between Sacramento and Stone Lakes National Wildlife Refuge
White-faced Ibis	*Plegadis chihi*	–	WL (rookeries)	–	Forages in wetlands and irrigated or flooded croplands and pastures; breeds colonially in dense freshwater marsh	Year-round resident in scattered locations in the Central Valley and Southern California; also nests in northeastern California; breeds in the Yolo Basin Wildlife Area, but there is a low likelihood of nesting in the remainder of the Delta and Suisun Marsh; may forage there during winter and migration

Table 4-2
Special-status Fish and Wildlife Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Common Name	Scientific Name	Legal Status		Other Status[c]	Habitat	Range and Potential to Occur
		Federal[a]	State[b]			
Purple martin	*Progne subis*	–	SSC (nesting)	–	Nests in tree cavities, bridges, utility poles, lava tubes, and buildings; forages in foothill and low montane oak and riparian woodlands, and less frequently in coniferous forests and open or developed habitats	Not expected in the Delta and Suisun Marsh except small numbers during migration; breeding range includes the Sierra Nevada, Cascade Range, portions of the Coast Ranges and coast, and parts of Southern California; migrates south of California in fall; extirpated from the Delta, and nesting in the Central Valley has been reduced to transportation structures in and around the city of Sacramento
California clapper rail	*Rallus longirostris obsoletus*	E	E, FP	–	Nests and forages in dense cordgrass and cattail marshes with vegetated refugia during the highest tides	Year-round near coastal range, surrounds San Francisco and San Pablo bays, and documented at several locations in Suisun Bay; range does not include the Delta
Bank swallow	*Riparia riparia*	–	T (nesting)	–	Nests in vertical banks or bluffs, typically adjacent to water, devoid of vegetation, and with friable, eroding soils; forages in a wide variety of habitats	Breeds in much of lowland and riparian California, with 75 percent nesting colonies along the Sacramento and Feather rivers and their tributaries; additional breeding locations are scattered throughout the northern and central portions of the state; migrates south of California in fall; low probability of nesting in much of the Delta and Suisun Marsh because suitable bank conditions are rare; however, one nesting colony has been documented in the Delta in Brannan Island State Recreation Area
California least tern	*Sternula antillarum browni*	E	E, FP	–	Prefers undisturbed nest sites on open or sparsely vegetated, sandy, or gravelly shores on beaches or near shallow-water estuaries where it often feeds; has reportedly also nested on landfills and paved areas	The Pacific Coast from San Francisco to Baja California; winters in Mexico; when feeding, follows schools of fish and is sometimes seen as far north as southern Oregon; documented nesting in the western portion of Delta in Suisun Bay

Table 4-2
Special-status Fish and Wildlife Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Common Name	Scientific Name	Legal Status		Other Status[c]	Habitat	Range and Potential to Occur
		Federal[a]	State[b]			
Least Bell's vireo	*Vireo bellii pusillus*	E	E	–	Nests and roosts in low riparian thickets of willows and shrubs, usually near water but sometimes along dry, intermittent streams; other associated vegetation includes cottonwood trees, blackberry, mulefat , and mesquite (in desert)	Formerly a common and widespread summer resident throughout Sacramento and San Joaquin valleys, and in the coastal valleys and foothills from Santa Clara County south, but its numbers have drastically declined, and the species has vanished from much of its California range; does not occur in the Delta, but could expand range with riparian restoration
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*	–	SSC (nesting)	–	Nests in freshwater emergent wetlands with dense vegetation and deep water, often along borders of lakes or ponds	Breeding range includes primarily the Central Valley, northeastern California, and portions of Southern California; most individuals migrate south of California in winter; may occur in freshwater marshes throughout the Delta, particularly in the southern half, but also known to occur in the northern portion of the Delta, south of the city of Sacramento
Mammals						
Pallid bat	*Antrozous pallidus*	–	SSC	–	Deserts, grasslands, shrublands, woodlands, and forests; most common in open, dry habitats; roosts in rock crevices, oak hollows, bridges, and buildings	Year-round range spans nearly all of California; may roost and forage throughout the Delta, with the highest likelihood in the uplands surrounding Clifton Court Forebay
Townsend's Big-eared bat	*Corynorhinus townsendii*	–	SSC	–	Typically roosts in caves; however, colonies of fewer than 100 individuals occasionally nest in buildings or bridges; forages in all habitats except alpine and subalpine, although most commonly in mesic forests and woodlands	Year-round range spans most of California except the highest elevations of the Sierra Nevada south of Lake Tahoe; low likelihood of occurrence in the Delta

Table 4-2
Special-status Fish and Wildlife Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Common Name	Scientific Name	Legal Status		Other Status[c]	Habitat	Range and Potential to Occur
		Federal[a]	State[b]			
Western mastiff bat	*Eumops perotis californicus*	–	SSC	–	Roosts in trees, rock crevices, and buildings in small colonies of fewer than 100 individuals; forages in a variety of grassland, shrub, and wooded habitats, including riparian and urban areas, although most commonly in open, arid lands	Year-round range spans most of California, with records absent from the northwest and northeast portions of the state; may occur throughout the Delta
Western red bat	*Lasiurus blossevillii*	–	SSC	–	Roosts primarily in tree foliage, occasionally shrubs; roosts in small family groups rather than large colonies as other bats; prefers habitat edges and mosaics with trees that are protected from above and open below with open areas for foraging, including grasslands, shrublands, and open woodlands	Year-round range spans the Central Valley, Sierra Nevada foothills, Coast Ranges, and coast except Humboldt and Del Norte counties; documented foraging in most habitat types in the Delta; roosting documented in the Delta in Brannan Island State Recreation Area
Riparian woodrat	*Neotoma fuscipes riparia*	E	–	–	Riparian forest, particularly dense willow thickets with an oak overstory	Extirpated from most of historic range and now restricted to Caswell Memorial State Park on the Stanislaus River, at the confluence with the San Joaquin River; not expected in the Delta
Big free-tailed bat	*Nyctinomops macrotis*	–	SSC	–	Roosts on high cliffs or rocky outcrops in low-lying, arid areas in Southern California	Rare and not thought to breed in California; more common in New Mexico, southern Arizona, and Texas; one female specimen collected in Contra Costa County in 1979, but others are all located in south and southeastern California; also 1916 CNDDB record from Suisun City
Salt marsh harvest mouse	*Reithrodontomys raviventris*	E	E	–	Saline emergent marshes with low, dense cover of vegetation (especially pickleweed) and higher elevation refugia	Year-round range includes the marshes surrounding Suisun, San Pablo, and San Francisco bays, with the Collinsville-Antioch area forming the eastern limit of the range; not expected in the Delta

Table 4-2
Special-status Fish and Wildlife Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Common Name	Scientific Name	Legal Status		Other Status[c]	Habitat	Range and Potential to Occur
		Federal[a]	State[b]			
Suisun shrew	*Sorex ornatus sinuosus*	–	SSC	–	Marshes bordering Suisun Bay and northern San Pablo Bay	Year-round range includes the marshes surrounding Suisun and San Pablo bays; not expected in the Delta
Riparian brush rabbit	*Sylvilagus bachmani riparius*	E	E	–	Dense thickets of brush associated with riparian habitats	Extirpated from most of historic range and now restricted to Caswell Memorial State Park on the Stanislaus River, at the confluence with the San Joaquin River, and an adjacent portion of an overflow channel; not expected in the Delta
American badger	*Taxidea taxus*	–	SSC	–	Drier open shrub, forest, and herbaceous habitats with friable soils	Year-round range spans all of California except the Humboldt and Del Norte coasts; documented in the Delta, north of Stone Lake; may occur elsewhere in the Delta, particularly in the southern portion near Clifton Court Forebay; most of the Delta, however, is too highly modified for this species
San Joaquin kit fox	*Vulpes macrotis mutica*	E	T	–	Grasslands and oak savannas with friable soils; home range sizes of 600–1,300 acres	Year-round range is fragmented throughout the San Joaquin Valley; breeding documented in May 2000 in the Delta near Clifton Court Forebay; not expected elsewhere in Delta because of lack of suitable habitat

Table 4-2
Special-status Fish and Wildlife Species Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Sources: CNDDB 2011; DFG 2009; USFWS 2008e, 2008d

[a] **U.S. Fish and Wildlife Service—Federal Listing Categories:**

E: Listed as endangered under the federal Endangered Species Act (ESA).

T: Listed as threatened under the federal ESA.

BCC: U.S. Fish and Wildlife Service bird of conservation concern.

C: Candidate for listing.

–: No status.

[b] **California Department of Fish and Game—State Listing Categories:**

E: Listed as endangered under California Endangered Species Act (CESA).

T: Listed as threatened under CESA.

FP: Fully protected under the California Fish and Game Code.

SSC: California species of special concern.

WL: California Department of Fish and Game watch list.

CFGC: Rookeries protected under the California Fish and Game Code.

–: No status.

[c] Other Status (CNDDB Conservation Status Ranks) (shown only for species without legal status)

Global Rank:

GH: Possibly Extinct (species)—Missing; known from only historical occurrences but still some hope of rediscovery.

G1: Critically Imperiled—At very high risk of extinction because of extreme rarity (often 5 or fewer populations), very steep declines, or other factors.

G2: Imperiled—At high risk of extinction because of very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.

G3: Vulnerable—At moderate risk of extinction because of a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.

G5: Secure—Common; widespread and abundant.

G#G#: Range Rank—A numeric range rank (e.g., G2G3) is used to indicate the range of uncertainty in the status of a species or community.

T: Infraspecific Taxon (trinomial)—The status of infraspecific taxa (subspecies or varieties) are indicated by a “T-rank” following the species’ global rank.

State Rank:

SH: Possibly Extirpated (Historical)—Species or community occurred historically in the state, and there is some possibility that it may be rediscovered.

S1: Critically Imperiled—Critically imperiled in the state because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state.

S2: Imperiled—Imperiled in the state because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the state.

S3: Vulnerable—Vulnerable in the state because of a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.

S#S#: Range Rank—A numeric range rank (e.g., S2S3) is used to indicate the range of uncertainty in the status of a species or community.

CNDDB: California Natural Diversity Database

Delta: Sacramento–San Joaquin Delta

Table 4-3
Invasive Plants and Noxious Weeds Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Scientific Name Common Name	Legal Status[a]			Habitat	Plant Type	Propagation/ Dispersal[b]	Presence in the Delta or Suisun Marsh	Impact Mechanism/ Notes[b]
	Federal	State	Cal-IPC					
Ailanthus altissima Tree of heaven	–	–	M	Riparian forest, riparian shrub, grassland, oak woodland	Tree	Vegetatively from root sprouts, seed/wind, water, animals	Known to occur	Impacts highest in riparian areas; dense clonal patches displace native plants and reduce wildlife habitat
Alternanthera philoxeroides Alligatorweed	–	A	H, A	Freshwater tidal and nontidal marsh, aquatic	Perennial herb	Vegetatively from stolons/water	Known to occur	Submerged aquatic vegetation; slows water flow; hinders navigation; reduces native biodiversity of plants, fish, wildlife
Arundo donax Giant reed	–	B	H	Riparian forest, riparian shrub, freshwater tidal and nontidal marsh	Perennial grass	Vegetatively from rhizomes and stem fragments/water, soil movement	Known to occur	Clonal patches alter stream dynamic, cause erosion, displace native plants, increase fire risks, and reduce fish and wildlife habitat quality
Azolla pinnata Mosquito fern, water velvet	NW	–	–	Aquatic	Free-floating fern	Vegetatively from stem fragments/water	Known to occur	Reduces oxygen and sunlight, effectively degrading habitat for native plants and aquatic organisms
Cabomba caroliniana Carolina fanwort	–	B	–	Aquatic	Perennial herb	Vegetatively from stem fragments, seed/water	Known to occur	Submerged aquatic vegetation; slows water flow; hinders navigation; reduces native biodiversity of plants, fish, and wildlife
Centaurea solstitialis Yellow star-thistle	–	C	H	Grassland	Annual herb	Seed/water, animals	Known to occur	Alters grassland structure and plant composition, reduces germination of oaks and other native plants through use of soil moisture
Conium maculatum Poison hemlock	–	–	M	Riparian forest, riparian scrub, seasonal wetlands	Perennial herb	Seed/water, animals	Known to occur	Competes with native plants; alters habitat structure

Table 4-3
Invasive Plants and Noxious Weeds Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Scientific Name Common Name	Legal Status[a]			Habitat	Plant Type	Propagation/ Dispersal[b]	Presence in the Delta or Suisun Marsh	Impact Mechanism/ Notes[b]
	Federal	State	Cal-IPC					
Cortaderia selloana Pampas grass	–	–	H	Riparian scrub, seasonal wetlands, grasslands	Perennial grass	Seed/wind	Known to occur	Competes with native plants; alters habitat structure; increases fire hazard
Cuscuta japonica Japanese dodder	NW	A	–	Riparian forest and scrub	Parasitic annual plant	Vegetatively from stem fragments, seed/water, animals	Could occur	Weakens native plants; noxious weed to agricultural crops, including orchards
Cynadon dactylon Bermuda grass	–	C	M	Riparian forest, riparian shrub, seasonal wetlands, alkaline seasonal wetlands, grassland	Perennial grass	Vegetatively from creeping stolons and rhizomes	Known to occur	Displaces riparian plants; alters grassland composition and structure
Egeria densa Brazilian waterweed	–	–	H	Aquatic	Submerged aquatic perennial	Vegetatively from stolons and stem fragments/water	Known to occur	Submerged aquatic vegetation; slows water flow; hinders navigation; reduces native biodiversity of plants, fish, wildlife
Eichhornia azurea Anchored water hyacinth	NW	–	–	Aquatic	Floating aquatic perennial	Vegetatively from stolons, seed/water	Could occur	Reduces oxygen and sunlight availability to native fish and aquatic organisms; increases dissolved organic carbon
Eichhornia crassipes Water hyacinth	–	–	H, A	Aquatic	Floating aquatic perennial	Vegetatively from stolons, seed/water	Known to occur	Reduces oxygen and sunlight availability to native fish and aquatic organisms; increases dissolved organic carbon; alters native fish habitat (e.g., delta smelt)
Eucalyptus camaldulensis Red gum	–	–	L	Riparian forest, grasslands, agricultural fields	Tree	Seed/wind	Could occur	Reduces native riparian plant and wildlife biodiversity; alters soils chemistry; causes high fire hazard

Table 4-3
Invasive Plants and Noxious Weeds Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Scientific Name Common Name	Legal Status[a]			Habitat	Plant Type	Propagation/ Dispersal[b]	Presence in the Delta or Suisun Marsh	Impact Mechanism/ Notes[b]
	Federal	State	Cal-IPC					
Eucalyptus globulus Tasmanian blue gum	–	–	M	Riparian forest, grasslands, agricultural fields	Tree	Seed/wind	Known to occur	Reduces native riparian plant and wildlife biodiversity; alters soils chemistry; causes high fire hazard
Ficus carica Fig	–	–	M	Riparian forest, riparian shrub	Tree, shrub	Seed/water, animals	Known to occur	Displaces native riparian vegetation
Foeniculum vulgare Fennel	–	–	H	Riparian scrub, grassland	Perennial herb	Seed/water, soil movement, animals	Known to occur	Displaces native plants; alters riparian scrub habitat structure and quality
Glyceria declinata Waxy mannagrass	–	–	M	Seasonal wetland, vernal pools	Perennial grass	Vegetatively from stolons, seed/animals	Known to occur	Displaces native vernal pool vegetation; likely alters water chemistry; likely alters habitat for vernal pool invertebrates
Hydrilla verticillata Hydrilla	NW	A	H	Aquatic	Submerged aquatic perennial	Vegetatively from stolons, stem fragments, tubers/water	Could occur	Submerged aquatic vegetation; slows water flow; hinders navigation; reduces native biodiversity of plants, fish, wildlife
Ipomoea aquatic Chinese water spinach	NW	–	–	Aquatic	Perennial vine	Unknown	Could occur	Grown as a greenhouse vegetable in southern California; unknown whether it is naturalized
Iris pseudacorus Yellowflag iris	–	Q	L	Riparian scrub, tidal and nontidal marsh, aquatic	Perennial herb	Vegetatively from rhizomes, seed/animals, water	Could occur	Displaces marsh and other wetlands plants; alters habitat structure and quality
Lepidium latifolium Perennial pepperweed	–	–	H	Seasonal wetland, tidal and nontidal marsh, riparian scrub and forest, grassland	Perennial herb	Vegetatively from rhizomes, seed/wind, water	Known to occur	Displaces native plants; alters soil chemistry; reduces biodiversity

Table 4-3
Invasive Plants and Noxious Weeds Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Scientific Name Common Name	Legal Status[a]			Habitat	Plant Type	Propagation/ Dispersal[b]	Presence in the Delta or Suisun Marsh	Impact Mechanism/ Notes[b]
	Federal	State	Cal-IPC					
Limnobium spongia, *L. laevigatum* Spongeplant	–	Q	–	Aquatic	Floating aquatic perennial	Vegetatively from stolons, seed/water	Could occur	Could impede navigation and degrade habitat for fish and other aquatic organisms
Limnophila indica, L. sessiliflora Ambulia	NW (*L. sessiliflora*)	Q	–	Aquatic	Submerged aquatic perennial	Vegetatively from fragments, seed/water	Could occur	Known from Florida, Georgia, and Texas; reportedly can outcompete hydrilla; aquarium plant; *L. indica*. X *L. sessiflora*. hybrid in rice paddies (WDNR 2009)
Ludwigia hexapetala Uruguay water primrose	–	–	H, A	Tidal and nontidal marsh, aquatic	Floating aquatic perennial	Vegetatively from stolons, seed/water	Known to occur	Nuisance to irrigation flows; impedes navigation in small channels
Ludwigia peploides ssp. *montevidensis* Creeping water primrose	–	–	H	Tidal and nontidal marsh, aquatic	Floating aquatic perennial	Vegetatively from stolons, seed/water	Known to occur	Nuisance to irrigation flows; impedes navigation in small channels
Lythrum salicaria Purple loosestrife	–	B	H	Tidal and nontidal marsh, aquatic	Perennial herb	Vegetatively from rhizomes, seed/water	Could occur	Alters composition of marsh communities
Myriophyllum aquaticum Parrot feather	–	–	H, A	Aquatic	Submerged aquatic perennial	Vegetatively from rhizomes and stem fragments/water	Known to occur	Submerged aquatic vegetation; slows water flow; hinders navigation; reduces native biodiversity of plants, fish, wildlife
Myriophyllum spicatum Eurasian milfoil	–	–	H	Aquatic	Submerged aquatic perennial	Vegetatively from rhizomes and stem fragments/water	Known to occur	Submerged aquatic vegetation; slows water flow; hinders navigation; reduces native biodiversity of plants, fish, wildlife

Table 4-3
Invasive Plants and Noxious Weeds Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Scientific Name Common Name	Legal Status[a]			Habitat	Plant Type	Propagation/ Dispersal[b]	Presence in the Delta or Suisun Marsh	Impact Mechanism/ Notes[b]
	Federal	State	Cal-IPC					
Nymphaea mexicana Mexican or banana water lily	–	B	–	Aquatic	Floating aquatic perennial	Vegetatively from stolons, seed/water	Could occur	Shallow channel nuisance; increases siltation and evapotranspiration rates and hinders recreation activities
Polygonum amphibium Swamp smartweed	–	C	–	Tidal and nontidal marsh, aquatic	Perennial herb	Vegetatively from rhizomes and stem fragments/water	Known to occur	May be a nuisance species in some irrigation canals
Robinia pseudoacacia Black locust	–	–	L	Riparian forest and scrub	Tree	Seed/animals	Known to occur	Displaces native riparian vegetation; reduces biodiversity of plants and wildlife
Rubus armeniacus (= R. discolor) Himalayan blackberry	–	–	H	Riparian forest and scrub, nontidal marsh, seasonal wetland, oak woodlands	Vine	Seed/animals	Known to occur	Displaces native riparian scrub; alters streamflow; can provide some habitat values for native and nonnative wildlife
Sagittaria sagittifolia Arrowhead	NW	–	–	Tidal and nontidal marsh	Emergent aquatic perennial herb	Seed/water	Could occur	Could be a nuisance plant in some channels by restricting flows
Salvinia auriculata (= *S. biloba*, *S. herzogii*, *S. molesta*) Salvinia	NW	A	H	Aquatic	Floating aquatic fern	Vegetatively from stem fragments/water	Could occur	Could impede navigation and alter aquatic habitat
Schinus terebinthifolius, *S. molle* Brazilian peppertree	–	–	L	Riparian forest and scrub	Tree	Seed/animals, water	Known to occur	Displaces native riparian vegetation; reduces biodiversity of plants and wildlife
Silybum marianum Blessed milk thistle	–	–	L	Riparian forest and scrub, seasonal wetland, grassland	Annual herb	Seed/animals, water	Known to occur	Displaces native grassland and riparian scrub plants; alters habitat structure and quality

Table 4-3
Invasive Plants and Noxious Weeds Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Scientific Name Common Name	Legal Status[a]			Habitat	Plant Type	Propagation/ Dispersal[b]	Presence in the Delta or Suisun Marsh	Impact Mechanism/ Notes[b]
	Federal	State	Cal-IPC					
Sesbania punicea Red sesbania	–	B	H, A	Riparian forest and scrub	Tree	Seed/animals, water	Known to occur	Displaces native riparian vegetation; reduces biodiversity of plants and wildlife
Tamarix chinensis, T. gallica, T. parviflora, T. ramosissima Chinese tamarisk, French tamarisk, Small flower tamarisk, salt cedar	–	B	H	In the Delta, riparian forest and scrub, alkaline seasonal wetland	Tree, shrub	Vegetatively from root sprouts, seeds/wind, water	Known to occur	Displaces native riparian plants; alters soil chemistry; causes fire hazard; alters streamflow; reduces biodiversity of plants, animals, and fish

Table 4-3
Invasive Plants and Noxious Weeds Known to Occur or with Potential to Occur in the Delta and Suisun Marsh

Sources: CAIP 2009; CALFED Bay-Delta Program 2000a, 2000b; Cal-IPC 2010; CDFA 2009; DFG 2007c, 2008c; DiTomaso and Healy 2003, 2007; DWR 2005a, 2005b; Hickson and Keeler-Wolf 2007; Jepson Flora Project 2009a, 2009b; Lower Putah Creek Coordinating Committee 2005; PWA et al. 2006; USDA 2006; WDNR 2009.

Note: Suitable habitat exists in the Delta or Suisun Marsh for all of the species listed in this table.

[a] Legal Status Definitions

Federal

NW: Regulated by the Federal Noxious Weed Act (Public Law 93-629).
For more details, see the discussion of the Noxious Weed Act in the subsection titled "Other Federal Authorities" in Appendix B of the California Aquatic Invasive Species Management Plan (DFG 2008c).

–: No status.

State

Noxious Weed Ratings per California Department of Food and Agriculture (CDFA) Plant Industry Policy Letter 89-2, April 28, 1989 (CDFA 2009):

A: An organism of known economic importance subject to enforced action involving eradication, containment, rejection, or other holding action at the State-county level. Quarantine interceptions to be rejected or treated at any point in the state.

B: An organism of known economic importance subject to eradication, containment, control or other holding action at the discretion of the commissioner or an organism of known economic importance subject to State holding action and eradication only when found in a nursery.

C: An organism subject to State-endorsed holding action and eradication only when found in a nursery; action to retard spread outside of nurseries at the discretion of the commissioner; reject only when found in a cropseed for planting or at the discretion of the commissioner.

Q: An organism requiring a temporary "A" action pending determination of a permanent rating. It is suspected to be of economic importance, but its status is uncertain because of incomplete identification or inadequate information.

–: No status.

Cal-IPC Inventory Ratings

A: Alert – Plants with the potential to spread explosively; infestations currently small and localized.

H: High – These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically.

M: Moderate – These species have substantial and apparent—but generally not severe—ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal, although establishment is generally dependent upon ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.

L: Limited – These species are invasive but their ecological impacts are minor on a statewide level or there was not enough information to justify a higher score. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic.

–: No status.

[b] Definitions in "Propagation/ Dispersal" and "Impact Mechanism/Notes" columns

Rhizome: A horizontal underground stem that contains nodes and reduced scaly leaves.

Seed: A ripened plant ovule containing an embryo, the result of sexual reproduction.

Stolon: Aboveground trailing shoot; roots form at nodes.

Vegetative reproduction : Asexual reproduction in plants, in which multicellular structures become detached from the parent plant and develop into new individuals that are genetically identical to the parent plant. Four species included in the original CAISMP table are not included in Table 4-3 for the following reasons:

Miramar weed is a federally listed noxious weed used in the aquarium trade but restricted from sale in the United States and not yet observed in the United States.

Broadleaf paper-bark tree is a major invasive tree in the Everglades and swamps of the southeastern United States, but has not been observed in the west.

Monochoria is a perennial invasive forb of marshes but is known only from the eastern United States.

Exotic bur-reed and water smartweed are listed as native to California.

Table 4-4
Area (in Acres) of Natural Community Types in the Delta and Suisun Marsh

Natural and Agricultural Community Types	Delta	Suisun Marsh	Area of Overlap[a]	Total for Delta and Suisun Marsh[b,c]
Tidal open water	56,150	25,720	1,160	80,750
Tidal brackish marsh	360	8,330	360	8,330
Tidal freshwater marsh	6,980	–	–	6,980
Nontidal open water	10,520	30	–	10,550
Nontidal brackish marsh, managed	2,540	49,490	1,860	50,180
Nontidal freshwater marsh, unmanaged	3,260	10	10	3,260
Nontidal freshwater marsh, managed	14,300	–	–	14,300
Alkali seasonal wetlands	5,470	170	100	5,530
Grasslands with vernal pools	8,930	1,150	10	10,080
Riparian forest	8,980	–	–	8,980
Riparian scrub	7,030	170	20	7,180
Riparian invasives	170	–	–	170
Grassland	53,480	16,310	580	69,200
Inland dune scrub	20	–	–	20
*Agricultural lands				
Alfalfa	82,410	–	–	82,410
Irrigated pasture	51,690	–	–	51,690
Corn	108,220	–	–	108,220
Rice	3,760	–	–	3,760
Vineyard	28,850	–	–	28,850
Orchard	17,960	–	–	17,960
Other cultivated crops	114,940	–	–	114,940
Other agriculture	69,760	2,840	120	72,480
Oak woodland	–	490	–	490
Developed	80,110	1,890	100	81,910
Undefined	–	20	–	20
Total[c]	**735,900**	**106,620**	**4,320**	**838,250**

Note: Numbers have been rounded to the nearest 10 acres.

[a] The Delta and Suisun Marsh areas overlap. The acreage shown represents the extent of overlapping acreage for each natural and agricultural community type.

[b] The total represents the combined acreage of the Delta and Suisun Marsh areas. The overlapping acreage is counted only once.

[c] The total may not equal the sum of the acreages for individual types because of rounding.

Table 4-5
Refuges and Wildlife Areas with Water Supplied by the CVPIA

Refuge	Acres	Water Supplies (acre-feet)		
		Level 2*	Level 4 Increment*	Total
Sacramento River Basin				
Sacramento NWR	10,819	46,400	3,600	50,000
Delevan NWR	5,797	20,950	9,050	30,000
Colusa NWR	4,567	25,000	0	25,000
Sutter NWR	2,591	23,500	6,500	30,000
Gray Lodge WA	9,100	35,400	8,600	44,000
San Joaquin River Basin				
San Luis NWR	26,600	49,947	24,448	74,395
Los Banos WA	6,217	16,670	8,330	25,000
Volta WA	2,891	10,000	6,000	16,000
North Grassland WA	7,069	13,647	6,823	20,470
Mendota WA	11,802	18,500	11,150	29,650
Grasslands RCD	75,000	125,000	55,000	180,000
Tulare Lake Basin				
Kern NWR	11,249	9,950	15,050	25,000
Pixley NWR	6,939	1,280	4,720	6,000

Sources: DFG 2011d, 2011e; USFWS 2011b, 2011c
* Levels 2 and 4 water supplies needed on the refuge per the Report on Refuge Water Supply Investigations (Reclamation 1989).